Approved by _____

Department Mechanical Engineering

Date May 5 1926

FLOW OF WATER THROUGH SMALL ORIFICES AND THE DETERMINATION OF THE COEFFICIENT OF DISCHARGE

A Thesis Presented for the Degree
of Master of Science

by

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1926

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The investigation for this thesis was carried out during the summer of 1925 in the Mechanical Engineering laboratory of Ohio State University under the direction of Prof. Horace Judd, Professor of Hydraulic Engineering.

During the winter of 1905–06, Prof. Judd and Prof. R. S. King investigated the flow of water through orifices of 0.75 to 2.50 inches in diameter. (Engineering News, September 27, 1906.)

Since this investigation showed that the coefficient of discharge increased with a decrease in diameter of the orifice, it seemed desirable to continue the investigation for extremely small orifices, especially since orifices as small as 3/32 inches in diameter are used in rapid sand filters for washing the filter. Also in the manufacture of Rayon openings as small as 0.002" to 0.004" are used with pressures up to 100#/□".

In 1907, Mr. H. J. I. Bilton conducted a series of experiments on the flow of water through small orifices. (Proceedings Victorian Institute of Engineers– Australia 1908). These experiments were conducted at low heads, the maximum head being 8 feet, and involved only two orifices smaller than 0.10 inch.

The present investigation endeavors to indicate the characteristics of orifices 0.10 inch and smaller when subjected to heads ranging from 2 to 250 feet.

The primary object of these experiments was to determine the coefficients of discharge for extremely small orifices and the effect on these coefficients of increasing the head to 250 feet.

A few of the characteristics of the jet were recorded for the various heads and an attempt was made to locate and measure the position of least section for the two largest orifices.

The results indicate a fairly consistent decrease in the coefficient of discharge at low heads as the head is increased up to a critical head and then decreased very slightly as the head is further increased. The head at which the coefficient of discharge becomes nearly constant varies for each orifice and is higher the smaller the orifice.

The two smallest orifices namely 0.00419 and 0.01487 inches in diameter, showed a different characteristic at low heads. As the head was decreased the coefficient of discharge increased until a critical head was reached beyond which the coefficient decreased very rapidly with

decrease in head. This probably indicates the effect of capilary attraction.

A study of the characteristics of the jet indicates that the length of the smooth section of the jet, the section over which the jet holds together, increases very rapidly at low heads but as the head is increased the increase in length of this section is less noticeable until a head is reached beyond which the jet begins to break up into a spray more quickly.

The apparatus used for these determinations is shown in figure (1). Two 4 inch sections of eight inch pipe were connected together with flanges as shown. Water was supplied at one end through a 3/8" pipe from the supply line. The other end was fitted with a 2-1/2" nipple, extra heavy and cap for holding the orifice plates. Figure (2). The blank flange on the discharge end had a 3 inch opening. This was bushed with a reducer to 2-1/2 inches. After the 2-1/2" nipple, about four inches in length, was screwed into the reducer the flange was chucked in a lathe and a rounded entrance turned in it in order to eliminate any eddies as the water entered the nipple. In order to increase the smoothness of this entrance all irregular surfaces were smoothed over with bee's wax and the entire surface coated with shellac.

The discharge end of the 2-1/2" nipple was faced off in the lathe in order to provide a bearing surface for the orifice plates to make a water tight joint. The orifice plates, made of spring brass 0.021 of an inch in thickness, were of such diameter that they would drop into the 2-1/2 inch cap. (Fig. 2) A lead gasket was placed in the cap and a slight recess turned in it for receiving the orifice plate. When the orifice was placed in the cap and the cap screwed up there was sufficient bearing surface between the brass plate and the end of the nipple to form a water tight joint.

There was a 1/2" hole in the center of the 2-1/2" cap which was counter sunk from the outside. This provided ample opening for the orifices and enabled the orifice plate to be well supported against the water pressure. (Fig. 2)

Three different means were provided for measuring the head. For the low heads up to 8 feet a water column was used, (B-Fig. 1), so that for these extremely low heads the head was measured directly in feet of water. For heads from 8 to 30 feet of water a mercury manometer was used (C-Fig. 1) For heads higher than 30 feet pressure gages were used (D-Fig. 1). Two pressure gages were used,

#7

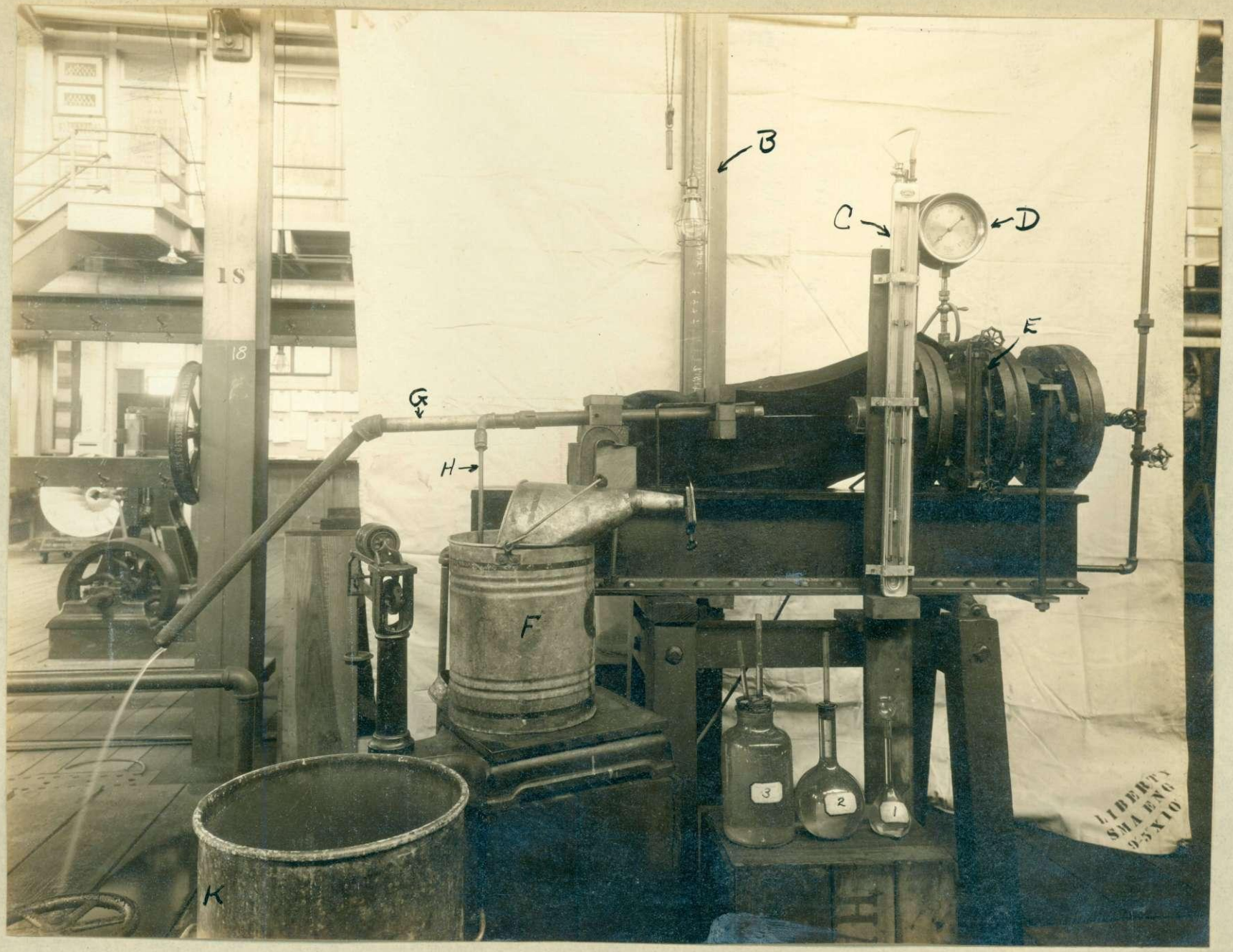


Figure 1

Figure 2

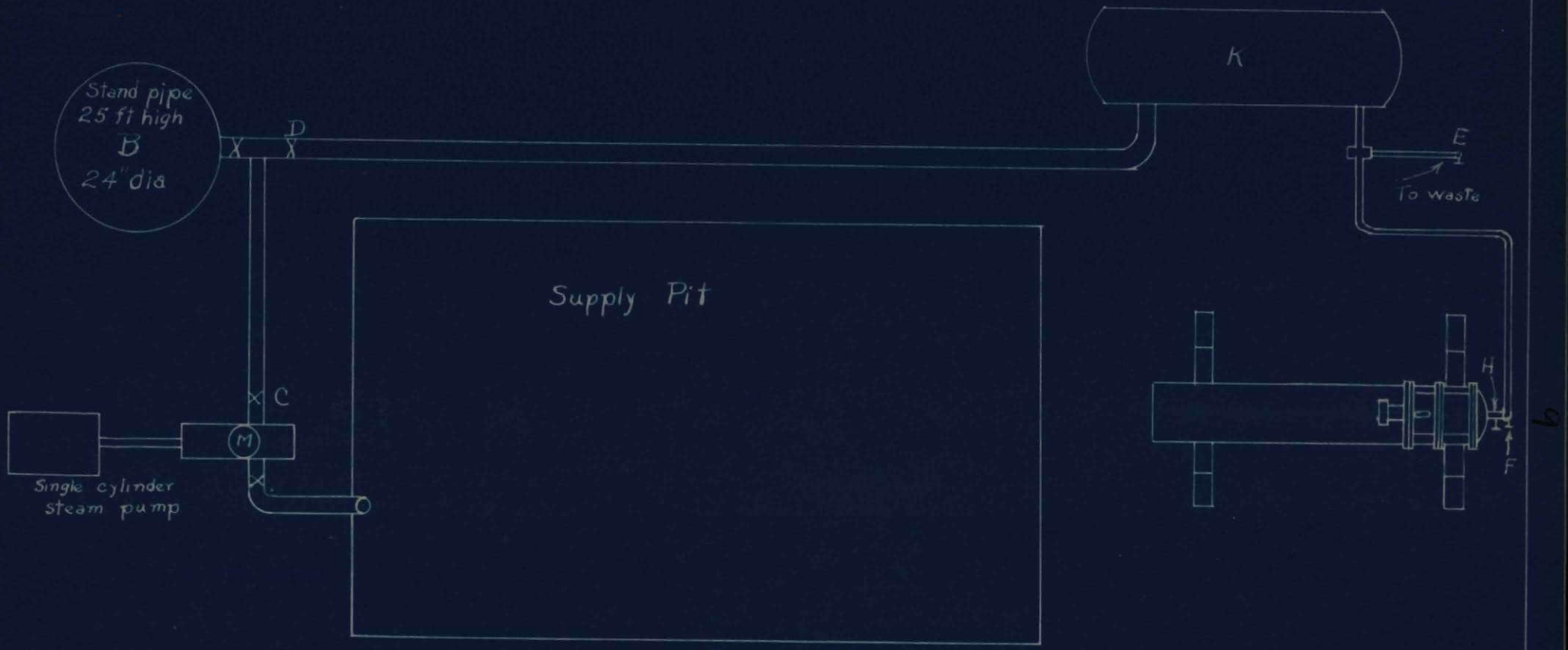


Figure 3

SKematic diagram
Apparatus used for
determination of the coefficient
of discharge of small
orifices
Mechanical Engineering Laboratory
Ohio State University
Summer 1925 Howell, R. S.

0 – 60 lb. range and 0 – 120 lb. range. The hand on each of the gages was filed very thin at the point in order to increase the accuracy of reading. Both gages were calibrated before using and the calibration checked four times during the progress of the tests. The density of the mercury used in the manometer was obtained by ratio of weights with sensitive balances and found to be 13.58.

The entire 8" sections were not filled with water as air was trapped in the upper portion for a cushioning effect. A gage glass was therefore connected to the top and bottom of one of these sections and a scale attached to the glass so that the position of the water level could always be seen. (E – Fig. 1) The manometers and gages were connected to the air space and so by means of the scale attached to gage glass the total head on the orifice could be determined.

The quantity of water discharged was measured in two different ways, depending upon the rate of flow. The method used for the larger orifices was by weight, as shown by the small scales and weighing can (F–Fig. 1). Two pipes (G and H –Fig. 1) were provided for directing the jet of water as desired. Pipe G – Fig. 1 conducts the water to waste as shown in the picture where it is discharging into a supply pit. Pipe H – Fig. 1 diverts the jet to the measuring apparatus. A larger weighing can K is shown which was used for the highest rates of flow. The second method for measuring the discharge was by volume measurement. Three different size measuring bottles, 1, 2, 3, are shown in figure 1. Scratch marks were provided on the smallest sections of these bottles for accurately determining the volume and this volume determined by weighing the water required to fill it. This weight was obtained on balances weighing to the nearest 1/100 lb. From the temperature of the water the volume was then computed. The volumes of the three bottles shown was found to be 0.0070694, 0.039203 and 0.76317 cu.ft. respectively. Another bottle not shown, was used having a volume of 0.092735 cu.ft. This bottle was broken before the picture was made. The larger bottles were provided with glass tubes to form the smallest section and a scratch mark was placed on these tubes. One tube was used for discharging the air while the bottle was being filled through the other one.

The water was supplied by means of a single cylinder reciprocating pump as shown in figure 3. The stand pipe B–Fig. 3 could be used for heads up to 25 feet and so for all heads under 25 feet water was pumped into the stand pipe from the supply pits and the pump shut down. The pump was used for all heads above 25 feet and it is evident that it was necessary to eliminate the pulsations of the pump

before the water was supplied to the orifice. This was satisfactorily accomplished by means of throttling the water and cushioning with air. Values C, D, E and F were used for throttling as well as value H. (Fig. 3) A tank (K—Fig. 3) provided an air cushion in addition to the air chamber, (M—Fig. 3), of the pump. Also, as has already been stated, an air cushion was provided in the 8" pipe sections which formed the testing drum. By having the pump pressure from 10 to 50 lbs. higher than that desired at the orifice the pulsation could be very effectively destroyed before the water entered the testing drum. Valve F—Fig. 1 was very useful for maintaining a constant head during a test. This valve simply by—passes the water to the supply pit. With this valve partly open the head was adjusted by means of valve H as nearly as possible to the desired valve. Then by regulating the flow through F a very sensitive regulation of the pressure in the testing drum could be obtained.

One of the most difficult parts of the investigation was the drilling of reasonably round holes, free from burrs and an accurate measurement of the size of hole obtained. In drilling the holes an attempt was first made by clamping 3 pieces tightly together and drilling through, with the hope that the center piece would be smooth. When put under a microscope however it was found that the center piece contained burrs on the side through which the drill entered as well as the side from which the drill emerged and due to the extreme smallness of the hole any attempt to remove the burr had the effect of rounding the opening. The best job obtained was done by the Foos Gas Engine Company of Springfield, Ohio. Having heard of their experience in drilling small holes for use in their injection oil engines, a set of discs were submitted to them with the requirements, namely as round a hole as possible, sharp edges, but free from burrs. For drilling the holes a high speed drill, making about 8,000 R. P. M. was used. In order to eliminate the burr a small drop of solder was placed on each side of the plate. After the hole was drilled through the solder and plate the solder was carefully scraped off. This produced a very smooth sharp edged hole and was the method used for all the orifices.

For measuring the size of the opening in each plate microphotographs were made of each hole by Prof. J. O. Lord of the Department of Metallurgy, Ohio State University. These photographs are shown in figures — 4 to 17, on pages 91—96. For measuring the magnification a photograph was taken of a difraction grating ruled to 1/10 millimeters with the camera set up in the same position as for the orifice plates. Fig. 4 Measurements were made to the nearest 0.01 inch on the plates

of these photographs. The magnification for the two smallest orifices was 200 and for all others 44.26. At least four diameters were measured in each case and the average taken.

When making a test for the coefficient of discharge the head was maintained as nearly constant as possible, by means of the regulating valves as previously explained and readings of the head recorded every 1 to 2 minutes, depending upon the length of run, and the average value used in the calculation. A stop watch was used for recording the time and when the discharge was determined by weight the run was usually terminated after some even number of minutes. As the scales used would weigh to the nearest 0.10 lb. the length of the run was such that an error of 1/20 lb. would effect the coefficient only in the 3rd. decimal place. Since for the smaller orifices and especially at low heads the rate of flow was such that this method of measurement required an excessively long run, the method of measuring by volume was used. This volume was obtained by using more sensitive balances. The temperature of the water was recorded so that the weight obtained might be accurately converted to volume.

Figure 2 shows the set up of the method used in measuring the diameter of the jet. The micrometers were fastened to a metal piece as shown, which could be moved in a groove in the top of a metal block. Movement in this groove was accomplished by means of a screw which could be operated with a screw driver. Only the jets from the two largest orifices, 0.1003 and 0.09028 inches diameter respectively, were calipered as a slight error in reading the micrometer caused a rapid increase in the error of area as the jets became smaller.

It was observed that the length of the smooth section of the jet, namely the distance the jet held together varied as the head was changed. An attempt was therefore made to measure the length of this section for the various heads in order to determine if some fixed relation existed between the head and this length.

It was somewhat difficult to accurately measure the length of this section as it was not altogether a stable quantity. This instability became more noticeable as the head was increased. The results of these measurements are shown in graphic form on pages 97 and 98.

All observations are tabulated in blue print form, pages 19 to 91.

It is estimated that this investigation involves 5,000 observations.

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice # 43
Nominal diameter 0.0890"
Actual diameter 0.09028" Actual area 0.000044454 sq. ft.

Howell, R. S.
Summer 1925

Run #	Total Head feet	Length of run seconds	Temp. of water F°	Theoretical velocity of water ft/sec	Quantity Discharged: Total lbs.	Unit cu.ft/sec	Theoretical cu.ft/sec.	Coef. of Discharge #
	2.10	1800	77	11.638	36.00	0.00032132	0.0005173	0.621
	4.38	1440	77	16.804	41.70	0.00046527	0.0007470	0.622
	8.57	1200	77	23.49	47.80	0.0006400	0.0010442	0.613
	19.37	720	77	26.00	52.55	0.00070359	0.0011558	0.608
	30.62	720	77	35.318	42.60	0.00095107	0.0015700	0.606
	47.54	720	77	44.406	52.90	0.00118046	0.0019740	0.598
	74.12	720	75	55.33	65.10	0.0014522	0.0024596	0.590
	100.98	720	75	69.09	81.65	0.0018214	0.0030713	0.593
10	132.73	720	75	80.64	95.00	0.00211924	0.0035847	0.590
11	165.70	720	75	132.73	108.80	0.00242708	0.00410995	0.590
12	202.91	600	75	104.309	121.20	0.0027037	0.0045925	0.588
13	239.33	600	75	114.31	111.85	0.0029951	0.0050815	0.589
				125.15	131.45	0.0032522	0.0055189	0.589
					cu.ft.			
4	2.05	234	78	11.50	0.76317	0.0003261	0.0005112	0.635
5	3.93	172	72	15.918	0.76317	0.0004437	0.0007076	0.627
6	7.48	127.2	72	22.00	0.76317	0.0006000	0.0009779	0.613

Orifice # 39
Nominal diameter 0.0995inches
Actual diameter 0.1003 inches Actual area 0.000054867 sq. ft.

	1.95	1800	77	11.206	11.206	0.00037846	0.00061484	0.616
	2.05	190.8	72	11.49	0.76317	0.000400	0.0006304	0.635
	4.03	1400	77	16.11	29.35	0.00055062	0.0008839	0.622
	4.19	135.8	72	16.69	0.76317	0.00056115	0.0009157	0.614
	8.01	1200	77	22.71	57.60	0.00077121	0.0012460	0.618
	8.41	600	72	23.276	29.20 lbs.	0.0007814	0.001277	0.612
					cu.ft.			
	11.28	960	77	27.00	54.00	0.00090376	0.0014814	0.610
	19.23	720	77	35.19	52.10	0.0011626	0.0019307	0.604
	30.46	720	77	44.29	65.20	0.001455	0.0024300	0.598
	50.05	600	75	56.77	68.80	0.0018417	0.0031149	0.591
	73.59	600	75	68.84	83.50	0.0022352	0.003777	0.591
	101.04	600	75	80.66	97.80	0.0026181	0.0044255	0.591
	132.09	600	75	92.231	111.20	0.0029767	0.0050604	0.588
	165.85	600	75	103.347	124.65	0.0033368	0.0056703	0.588
	197.06	600	75	112.65	136.80	0.003662	0.0061807	0.590
	229.81	540	75	121.65	132.40	0.0039381	0.0066748	0.589

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice # 50

Howell, R. S.
Summer 1925

ominal diameter 0.0700"
ctual diameter 0.07004" Actual area 0.000026756 sq. ft.

un #	Total Head feet	Length of run seconds	Temp. of water F°	Theoretical velocity of water ft/sec.	Quantity Discharged: Total lbs.	Unit cu.ft/sec.	Theoretical cu.ft/sec.	Coef of Discharg #
	1.95	443	77	11.205	0.092735 cu. ft.	0.00020939	0.0002998	0.700
	3.99	324.5	77	16.036	0.092735 lbs.	0.00028577	0.0004291	0.666
	8.50	1200	76	23.40	29.90	0.00040027	0.0006261	0.639
	12.52	1200	76	28.39	35.97	0.00048152	0.00075968	0.633
	19.54	1200	76	35.477	44.48	0.00059545	0.00094922	0.627
	30.70	1200	76	44.47	55.35.	0.000741	0.0011898	0.623
	49.98	1200	75	56.73	69.75	0.00093626	0.0015178	0.617
	78.16	1080	75	70.947	78.25	0.0011637	0.0018982	0.613
	106.06	1080	75	82.645	91.15	0.0013555	0.0022112	0.613
0	138.07	960	75	94.296	91.95	0.0015384	0.0025229	0.610
1	169.98	960	75	104.62	102.10	0.0017083	0.0027992	0.611
2	205.70	960	75	115.10	112.25	0.001878	0.0030796	0.609
3	238.02	900	75	123.81	113.35	0.0020228	0.0033126	0.610

Orifice # 46

ominal diameter 0.0810"
ctual diameter 0.0818" Actual area 0.000036496 sq. ft.

	1.77	347.6	76	10.631	0.092735 cu. ft.	0.00026679	0.00038798	0.687
	3.84	251.6	76	15.725	0.092735 lbs.	0.00036858	0.00057389	0.642
	8.35	960	76	23.189	31.52	0.00052753	0.00084630	0.623
	11.97	966	76	27.764	37.45	0.00062677	0.00101327	0.619
	19.47	960	76	35.408	47.25	0.00079079	0.001289225	0.612
	30.50	960	76	44.32	58.60	0.00098075	0.0016175	0.606
	47.06	960	76	56.11	71.85	0.00120251	0.0020091	0.598
	73.18	960	76	68.65	89.65	0.0015004	0.0025035	0.599
	101.44	960	76	80.825	105.30	0.0017623	0.0029476	0.598
	133.34	960	76	92.666	120.55	0.00201757	0.0033794	0.597
	165.85	960	76	103.34	134.15	0.0022451	0.0037687	0.596
	200.26	840	76	113.56	128.85	0.0024641	0.0041415	0.595
	238.73	720	76	124.00	120.75	0.0026941	0.0045221	0.595

DETERMINATION OF THE COEFFICENT OF DISCHARGE OF SMALL ORIFICES

Orifice USED — Drill #55 — Howell, R. S.
Nominal diameter 0.0520 inches — Summer 1925
Actual diameter 0.0522 inches — Actual area 0.000014878 sq. ft.

Run	Total Head feet	Length of run seconds	Temp. of water F°	Theoretical velocity of water ft/sec	Quantity Discharged: Total lbs.	Quantity Discharged: Unit cu.ft/sec	Theoretical cu.ft/sec.	Coef of Discharge #
					cu.ft.			
	1.84	755.8	81	10.885	0.092735	0.00012269	0.00016194	0.757
	1.76	778.2	81	10.646	0.092735	0.00011904	0.00015839	0.752
	4.21	550	81	16.465	0.092735	0.00016861	0.00024496	0.688
	4.17	554.6	81	16.388	0.092735	0.00016721	0.00024361	0.687
	4.16	556.6	78	16.367	0.92735	0.00016661	0.0002435	0.684
	8.24	3000	78	23.044	lbs. 41.85	0.00022413	0.00034284	0.654
	11.80	2160	78	27.579	35.60	0.00026481	0.00041032	0.645
	8.38	337.9	80	23.23	cu.ft. 0.75317	0.00022585	0.0003456	0.653
					lbs.			
	19.35	1800	78	35.305	37.55	0.00033517	0.00052526	0.638
0	30.93	1800	74	44.63	46.90	0.00041842	0.00066400	0.630
1	56.15	1800	74	60.14	62.60	0.00055849	0.0008946	0.624
2	77.85	1800	74	70.806	73.10	0.00065217	0.00105345	0.620
3	102.44	1800	74	81.225	83.45	0.00074451	0.00120846	0.616
4	125.92	1800	75	90.05	92.10	0.00082182	0.0013397	0.613
5	149.43	1800	75	98.088	100.78	0.00089927	0.0014593	0.616
6	172.82	1800	75	105.459	107.98	0.00096352	0.0015695	0.613
7	196.18	1800	75	112.41	112.41	0.00102616	0.0016724	0.613
8	221.63	1800	75	119.465	122.38	0.0010920	0.0017774	0.614
9	243.23	1800	75	125.33	124.58	0.00111164	0.0018620	0.597

Orifice # 53

Nominal Diameter 0.0595"
Actual diameter 0.05989" — Actual area 0.000019563 sq. ft.

					cu.ft			
	1.76	572.8	74	10.667	0.092735	0.00016189	0.00020867	0.776
	1.80	561.6	74	10.781	0.092735	0.00016512	0.00021091	0.782
	4.015	409	74	16.08	0.092735	0.000227	0.00031457	0.721
	8.35	297.6	74	23.621	0.092735	0.00031127	0.0004621	0.673
	12.21	1800	74	28.047	lbs. 41.51	0.00037043	0.00054868	0.675
	20.63	1800	74	36.454	53.20	0.00047463	0.00071314	0.665
	30.83	1800	74	44.558	64.55	0.0005759	0.00087169	0.661
	53.40	1800	74	58.645	83.60	0.0007459	0.0011473	0.650
	79.00	1800	74	71.323	101.40	0.00090466	0.0013953	0.648
)	106.96	1800	75	93.00	117.50	0.00104847	0.0016237	0.646
1	139.26	1200	75	94.70	89.3	0.0011952	0.0018526	0.645
2	170.76	1200	75	104.86	98.75	0.0013217	0.0020513	0.644
3	205.36	1200	75	115.00	107.95	0.0014449	0.0022497	0.642
4	243.07	1200	75	125.114	116.90	0.001562	0.0024405	0.640

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used Drill #68
Nominal diameter 0.0310 inches
Actual diameter 0.0314 inches
Actual area 0.00053776 sq.ft.

Howell, R. S.
Summer 1925

Run #	Total Head feet	Length of run seconds	Temp. of water F°	Theoretical velocity of water ft/sec.	Quantity Discharged: Total lbs.	Unit cu.ft/sec	Theoretical cu.ft/sec.	Coef. of Discharge #
	3.34	10,800	74.5	14.22	42.42 cu.ft.	0.00006307	0.00007642	0.825
	7.49	475.4	72	22.00	0.039203 lbs.	0.00008246	0.0001131	0.700
	10.47	7,200	73.5	25.97	43.20	0.00009635	0.0001396	0.692
	19.53	5,400	75	35.46	43.30	0.0001288	0.00019068	0.675
	31.20	4,200	73	44.82	41.48	0.0001586	0.0002410	0.658
	54.17	3,360	73	59.06	43.00	0.0002055	0.0003176	0.647
	81.26	2,820	73	72.34	44.08	0.00025098	0.0003890	0.645
	104.52	2,460	73	82.04	43.30	0.0002826	0.00044117	0.641
	128.4	3,600	74	90.93	69.91	0.00031186	0.0004890	0.638
0	151.73	3,600	74	98.85	75.85	0.00033835	0.00053157	0.637
1	172.31	3,600	73	105.34	80.90	0.00036088	0.00056647	0.637
2	194.77	3,600	73	112.0	86.0	0.0003835	0.0006022	0.636
3	218.96	3,600	73	118.66	90.90	0.00040543	0.0006381	0.635
4	243.77	3,600	73	125.29	95.70	0.0004268	0.00067375	0.633

Orifice used Drill #60
ominal diameter 0.0410 inches
ctual diameter 0.0411 inches
Actual area 0.0000092132 sq. ft.

	4.21	5,400	74	16.47	37.87 cu.ft.	0.00011262	0.0001517	0.742
	4.27	814.5	74	16.58	0.092735	0.00011385	0.00015275	0.745
	8.25	619	74	23.05	0.092735	0.00014981	0.00021235	0.705
	20.60	411	74	36.42	0.092735 lbs.	0.00022563	0.00033554	0.672
	20.61	3,000	74	36.43	42.1	0.00022536	0.0003356	0.672
	30.30	2,400	74	44.17	40.42	0.00027046	0.00040697	0.664
	54.07	1,800	74	59.01	39.70	0.00035419	0.00054367	0.651
	76.90	1,680	73	70.37	43.95	0.00042005	0.00064836	0.648
	100.48	1,800	73	80.44	53.72	0.00047920	0.0007411	0.646
0	125.98	1,800	73	90.07	60.16	0.00053664	0.00082986	0.646
1	148.61	1,800	73	97.83	65.30	0.00058247	0.00090132	0.646
3	173.11	1,800	73	105.59	70.33	0.00062736	0.00097268	0.645
3	195.97	1,800	73	112.34	74.76	0.00066688	0.0010349	0.644
4	219.25	1,800	74.5	118.83	78.98	0.00070463	0.0010946	0.643
5	244.06	1,800	74.5	125.37	83.20	0.00074228	0.0011549	0.642

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used Drill #80

Howell, R. S.
Summer 1925

ominal diameter 0.0135 inches
ctual diameter 0.01491 inches Actual area 0.0000012125 sq. ft.

un	Total Head feet	Length of run seconds	Temp. of water F°	Theoretical velocity of water ft/sec.	Quantity Discharged: Total lbs.	Quantity Discharged: Unit cu.ft/sec	Theoretical cu.ft/sec.	Coef of Dis-charg
	1.96	600	81	11.108	cu. ft. 0.0070694 lbs.	0.00001177	0.00001347	0.874
	3.75	32,400	73.5	15.55	34.05	0.00001687	0.00001885	0.895
	8.01	21,600	74	22.71	33.90	0.00002520	0.00002754	0.915
	12.72	18,000	72	28.62	36.06	0.00003216	0.00003470	0.927
	15.98	1,074	81	32.079	cu. ft. 0.039203 lbs.	0.00003650	0.00003858	0.946
	19.48	14,400	71	35.42	36.60	0.00004080	0.00004295	0.950
	31.24	9,120	73	44.86	28.18	0.00004963	0.00005439	0.913
	54.41	7,800	72	59.194	31.08	0.00006397	0.00007177	0.892
	78.91	7,800	72	71.286	36.68	0.00007550	0.00008643	0.874
0	101.11	7,200	70	80.690	38.35	0.00008558	0.00009784	0.875
1	128.37	7,200	72	90.92	42.80	0.00009544	0.00011024	0.866
3	149.11	6,600	71	98.00	42.08	0.00010236	0.00011883	0.861
3	171.90	6,540	70	105.21	44.37	0.0001089	0.00012757	0.854
4	195.75	6,000	68	112.277	43.65	0.00011673	0.00013614	0.858
5	218.6	5,400	72	118.65	41.02	0.00012197	0.00014386	0.849
6	241.41	1,200	72	124.74	33.42	0.00012776	0.00015125	0.845

Orifice used Drill #76

ominal diameter 0.0200 inches
ctual diameter 0.02005 inches Actual area 0.0000021926 sq. ft.

	4.28	19,200	73	16.61	38.04	0.00003181	0.000036419	0.874
	10.51	10,800	75	26.02	30.62	0.00004553	0.00005705	0.798
	31.32	7,200	72	44.914	32.67	0.00007287	0.00009847	0.739
	54.56	6,600	74	59.28	38.10	0.00009270	0.00012997	0.713
	78.19	6,000	74.5	70.99	42.50	0.00011348	0.00015558	0.728
	101.48	5,400	72	80.92	43.20	0.0001284	0.0001774	0.724
	123.77	4,200	72	89.28	37.20	0.0001422	0.0001958	0.726
	147.83	4,200	72	97.57	40.60	0.0001552	0.0002139	0.725
	171.20	4,200	74.5	105.00	43.42	0.0001660	0.0002302	0.721
0	194.41	3,600	74.5	111.88	39.72	0.0001772	0.00024523	0.722
	217.70	3,600	74.5	118.41	41.92	0.0001870	0.0002596	0.720
2	242.72	3,600	74.5	125.02	44.30	0.0001976	0.0002741	0.720

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used Drill size 0.004"

Howell, R. S.
Summer 1925

Actual diameter 0.00419
Actual area 0,000000095754 sq. ft.

Run	Total Head feet	Length of run seconds	Temp. of water F°	Theoretical velocity of water ft/sec.	Quantity Discharged: Total cu.ft.	Unit CU.ft/sec.	Theoretical cu.ft/sec.	Coe of Di char #
	2.15	7611	83	11.786	0.0070694	0.000000928	0.000001128	0.8
	4.39	4918	83	16.823	0.0070694	0.000001437	0.000001610	0.8
	8.27	3315	83	23.077	0.0070694	0.000002132	0.000002209	0.9
	11.80	2718	83	27.566	0.0070694	0.000002600	0.000002639	0.9
	20.85	202.6	83	36.643	0.0070694	0.000003484	0.000003587	0.9
	32.50	1650	83	45.75	0.0070694	0.000004284	0.000004380	0.9
	50.02	1350	80	56.756	0.0070694	0.000005236	0.000005434	0.9
	73.11	1117	80	68.617	0.0070694	0.000006328	0.000006570	0.9
	100.69	961	80	80.526	0.0070694	0.000007356	0.000007710	0.9
0	132.35	846.8	80	92.321	0.0070694	0.000008348	0.000008840	0.9
1	164.68	765	80	103.982	0.0070694	0.000009241	0.000009860	0.9
2	201.89	692.4	80	114.025	0.0070694	0.000010210	0.000010935	0.9
3	243.61	632	80	125.35	0.0070694	0.000011185	0.000011993	0.9

DETERMIN ATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 17, 1926

Size of orifice used # 76
Temp. water 74.5°F

Run #	Time hr-min-sec: Stop watch #5	Head #/□" 818446	Water column: inches	Weight water and can lbs. 28x36268	Run #	Time hr-min-sec: Stop watch #5	Head #/□" 818446	Water column: inches	Weight water and can lbs. 28x36268
	0		5			0		5.0	
	10-20-0	104.0	8.2	5.20	44	2-10-0	94.1		
	10-22-0	104.2			45	2-12-0	94.0		
	10-24-0	104.0			46	2-14-0	93.8		
	10-26-0	103.8			47	2-16-0	93.8		
5	10-28-0	104.0			48	2-18-0	94.0		
	10-30-0	104.0			49	2-20-0	94.0		
	10-32-0	104.0			50	2-22-0	93.8		
	10-34-0	103.8			51	2-24-0	94.1		
	10-36-0	103.8			52	2626-0	94.0	8.35	
0	10-38-0	103.5			53	2-28-0	94.0		
1	10-40-0	103.8			54	2-30-0	94.1		
2	10-42-0	104.0			55	2-32-0	94.0		
3	10-44-0	104.0			56	2-34-0	94.0		
4	10-46-0	104.2			57	2-36-0	93.8		
5	10-48-0	104.0			58	2-38-0	94.0		
6	10-50-0	104.2			59	2-40-0	94.0		
7	10-52-0	104.0			60	2-42-0	94.0		
8	10-54-0	103.8			61	2-44-0	94.0		
9	10-56-0	104.0			62	2-46-0	94.0	9.10	47.1
0	10-58-0	104.0			63	3-10-0	84.0	7.95	5.18
1	11-0 -0	104.0	8.55		64	3-12-0	84.2		
2	11-02-0	104.0			65	3-14-0	83.9		
3	11-04-0	104.0			66	3-16-0	84.2		
4	11-06-0	104.0			67	3-18-0	84.1		
5	11-08-0	104.0			68	3-20-0	84.0		
6	11-10-0	104.2			69	3-22-0	84.0		
7	11-12-0	104.0			70	3-24-0	84.0		
8	11-14-0	104.2			71	3-26-0	84.0		
9	11-16-0	104.0			72	3-28-0	83.8		
0	11-18-0	104.0			73	3-30-0	84.0	8.45	
1	11-20-0	104.0	9.50	49.5	74	3-32-0	84.0		
2	1-46-0	94.0	7.8	5.18	75	3-34-0	84.0		
3	1-48-0	94.2			76	3-36-0	83.8		
4	1-50-0	94.2			77	3-38-0	84.0		
5	1-52-0	94.1			78	3-40-0	83.8		
6	1-54-0	94.0			79	3-42-0	84.0		
7	1-56-0	94.2			80	3-44-0	84.0		
8	1-58-0	94.0			81	3-46-0	84.4		
9	2- 0-0	94.1			82	3-48-0	84.0		
0	2-02-0	94.1			83	3-50-0	84.0	9.70	
1	2-04-0	94.1			84	3-52-0	84.0		
2	2-06-0	94.1	8.05		85	3 -54-0	84.0		
3	2-08-0	94.1			86	3-56-0	84.0		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

ize of orifice used # 76 — Howell, R. S.
emp. water 74.5°F — July 17, 1926

un: #	Time hr-min-sec: Stop watch: #5	Head #/□" : 818446	Water: column: inches	Weight water and can lbs. 28x36268
	0	5		
7	3-58-0	84.0		
8	4-0-0	84.0		
9	4-02-0	84.0		
0	4-04-0	84.0		
	4-06-0	84.0		
2	4-08-0	84.0		
3	4-10-0	84.0	11.2	44.9
4	4-30-0	74.0	7.75	5.18
5	4-32-0	74.4		
6	4-34-0	74.0		
7	4-36-0	73.9		
8	4-38-0	73.8		
9	4-40-0	73.5		
00	4-42-0	73.6		
01	4-44-0	73.6		
02	4-46-0	73.6		
03	4-48-0	73.9		
04	4-50-0	74.1	7.90	
05	4-52-0	74.2		
06	4-54-0	74.2		
07	4-56-0	74.0		
08	4-58-0	73.8		
09	5-0-0	74.0		
10	5-02-0	74.1		
11	5-04-0	74.0		
12	5-06-0	74.0		
13	5-08-0	74.0		
14	5-10-0	73.9	8.20	
15	5-12-0	73.9		
16	5-14-0	73.9		
17	5-16-0	74.0		
18	5-18-0	74.3		
19	5-30-0	74.3	8.30	
20	5-32-0	74.3		
21	5-34-0	74.2		
22	5-36-0	74.1		
23	5-38-0	74.0		
24	5-30-0	74.0	8.40	
25	5-32-0	74.0		
26	5-34-0	74.0		
27	5-36-0	74.0		
28	5-38-0	74.0		
29	5-40-0	74.0	8.55	48.60

July 18, 1926
Temp water 72°F

Run #	Time hr-min-sec: Stop watch: #5	Head #/□" : 818446	Water: column: inches	Weight water and can lbs. 28x36268
	0	5		
1	8-22-0	64.0	7.7	5.18
2	8-24-0	64.0		
3	8-26-0	64.0		
4	8-28-0	64.1		
5	8-30-0	64.1		
6	8-32-0	64.0		
7	8-34-0	64.0		
8	8-36-0	63.9		
9	8-38-0	64.0		
10	8-40-0	64.0		
11	8-42-0	63.8	7.85	
12	8-44-0	63.6		
13	8-46-0	63.5		
14	8-48-0	63.8		
15	8-50-0	63.9		
16	8-52-0	64.0		
17	8-54-0	64.0		
18	8-56-0	63.8		
19	8-58-0	63.8		
20	9-0-0	63.8		
21	9-02-0	64;0	8.00	
22	9-04-0	64.2		
23	9-06-0	64.2		
24	9-08-0	64.4		
25	9-10-0	64.2		
26	9-12-0	64.0	8.10	
27	9-14-0	64.1		
28	9-16-0	64.0		
29	9-18-0	63.8		
30	9-20-0	63.8		
31	9-22-0	64.0		
32	9-24-0	64.0		
33	9-26-0	63.9		
34	9-28-0	63.9		
35	9-30-0	64.0		
36	9-32-0	64.1	8.20	45.78
37	9-54-0	54.0	7.1	5.18
38	9-56-0	53.8		
39	9-58-0	54.1		
40	10-0-0	54.0		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Size of orifice used # 76
Temp water 72°F

Run #	Time hr-min-sec; Stop watch # 5	Head #/□" 818446	Water column: inches	Weight water and can lbs. 28x36268	Run #	Time hr-min-sec; Stop watch #5	Head #/□" 818446	Water column: inches	Weight water and can lbs. 28x36268
	0	5				0	5		
	10-02-0	53.9			83	11-40-0	44.2	7.35	
	10-04-0	53.9			84	11-42-0	43.8		
	10-06-0	53.9			85	11-44-0	43.5		
	10-08-0	54.0			86	11-46-0	43.9		
	10-10-0	54.0			87	11-48-0	44.0		
	10-12-0	54.0			88	11-50-0	44.1		
	10-14-0	54.0	7.30		89	11-52-0	44.0		
	10-16-0	54.0			90	11-54-0	44.0		
	10-18-0	53.9			91	11-56-0	44.0		
	10-20-0	53.8			92	11-58-0	43.8		
	10-22-0	53.9			93	12- 0-0	43.9	7.45	
	10-24-0	54.1			94	12-02-0	43.9		
	10-26-0	53.9			95	12-04-0	43.9		
	10-28-0	54.0			96	12-06-0	44.0		
	10-30-0	54.2			97	12-08-0	43.9		
	10-32-0	54.1			98	12-10-0	43.8		
	10-34-0	54.0	7.3		99	12-12-0	43.9		
	10-36-0	54.0			100	12-14-0	44.4		
	10-38-0	53.9			101	12-16-0	44.5		
	10-40-0	53.9			102	12-18-0	44.2		
	10-42-0	54.0			103	12-20-0	44.0	7.55	
	10-44-0	54.0	7.35		104	12-22-0	44.0		
	10-46-0	54.0			105	12-24-0	44.0		
	10-48-0	54.0			106	12-26-0	44.0		
	10-50-0	54.0			107	12-28-0	43.9		
	10-52-0	54.0			108	12-30-0	44.0		
	10-54-0	54.1	7.4		109	12-32-0	43.8		
	10-56-0	54.0			110	12-34-0	43.8		
	10-58-0	54.0			111	12-36-0	43.8		
	11 -0-0	53.9			112	12-38-0	43.8		
	11-02-0	53.8			113	12-40-0	43.8	7.65	
	11-04-0	53.9	7.45	42.38	114	12-42-0	43.8		
	11-20-0	44.0	7.3	5.18	115	12-44-0	43.8		
	11-22-0	44.0			116	12-46-0	44.0		
	11-24-0	44.0			117	12-48-0	44.0		
	11-26-0	44.0			118	12-50-0	44.0	7.70	48.38
	11-28-0	43.9							
	11-30-0	43.8							
	11-32-0	43.8							
	11-34-0	44.0							
	11-36-0	44.0							
	11-38-0	44.0							

July 20, 1925

Temp water 74.5°F

1	8-32-0	34.0	7.5	5.18
2	8-34-0	34.1		
3	8-36-0	34.0		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 76

July 20, 1925 — Howell, R. S.

Run #	Time hr-min-sec: Stop watch # 5	Head #/□" Crosby: 686317	Water column inches	Weight water and can lbs. 28x36268
		0 5		
	8-38-0	34.0		
	8-40-0	33.9		
	8-42-0	34.0		
	8-44-0	33.8		
	8-46-0	34.0		
	8-48-0	34.0		
0	8-50-0	33.9		
1	8-52-0	33.8	7.6	
3	8-54-0	33.6		
3	8-56-0	33.5		
4	8-58-0	33.5		
5	9-00-0	33.9		
6	9-02-0	34.1		
7	9-04-0	34.0		
8	9-06-0	33.9		
9	9-08-0	34.0		
0	9-10-0	34.0		
1	9-12-0	34.0	7.7	
2	9-14-0	33.9		
3	9-16-0	34.2		
4	9-18-0	34.3		
5	9-20-0	34.5		
6	9-22-0	34.6		
8	9-24-0	34.3		
9	9-26-0	34.1		
0	9-28-0	34.4		
1	9-30-0	34.4		
3	9-32-0	34.1	7.8	
3	9-34-0	33.8		
4	9-36-0	34.1		
5	9-38-0	34.1		
6	9-40-0	34.0		
7	9-42-0	34.0		
8	9-44-0	34.1		
9	9-46-0	34.1		
0	9-48-0	34.2		
1	9-50-0	34.3		
3	9-52-0	34.1	7.95	
5	9-54-0	34.0		
4	9-56-0	34.0		
5	9-58-0	34.4		
6	10-00-0	34.2		
7	10-02-0	34.2	8.00	
8	10-04-0	34.4		
49	10-06-0	33.9		
50	10-08-0	33.8		
51	10-10-0	34.1		
52	10-12-0	34.0	8.05	47.68
				July 21, 1925
1	7-52-0	24.0	7.5	5.18
2	7-54-0	23.6		
3	7-56-0	23.8		
4	7-58-0	23.9		
5	8-00-0	24.2		
6	8-02-0	24.1		
7	8-04-0	23.9		
8	8-06-0	23.6		
9	8-08-0	23.8		
10	8-10-0	24.2		
11	8-12-0	24.3	7.6	
12	8-14-0	24.3		
13	8-16-0	24.1		
14	8-18-0	23.8		
15	8-20-0	23.8		
16	8-22-0	23.9		
17	8-24-0	23.9		
18	8-26-0	24.1		
19	8-28-0	23.8		
20	8-30-0	23.8		
21	8-32-0	24.0	7.70	
22	8-34-0	24.2		
23	8-36-0	2411		
24	8-38-0	24.0		
25	8-40-0	24.0		
26	8-42-0	23.9	7.75	
27	8-44-0	24.2		
28	8-46-0	24.2		
29	8-48-0	24.3		
30	8-50-0	24.2		
31	8-52-0	24.1	7.80	
32	8-54-0	24.1		
33	8-56-0	23.9		
34	8-58-0	23.6		
35	9-00-0	24.1		
36	9-02-0	24.3	7.85	
37	9-04-0	24.3		
38	9-06-0	24.5		

DETERMINATION OF THE COEFFICENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

rifice used # 76
uly 21, 1926

Run #	Time: hr-min-sec: Stop watch #5	Head #/□" Crosby 686317	Water column: inches	Weight water and can lbs. 28x36268
		0	5.00	
9	9-08-0	24.1		
0	9-10-0	24.3		
1	9-12-0	23.8	7.90	
2	9-14-0	23.6		
3	9-16-0	23.9		
4	9-18-0	23.9		
5	9-20-0	23.9		
6	9-22-0	24.0	7.95	
7	9-24-0	24.0		
8	9-26-0	24.0		
9	9-28-0	24.3		
0	9-30-0	24.1		
1	9-32-0	24.3	8.00	
2	9-3460	24.0		
3	9-36-0	24.0		
4	9-38-0	24.0		
5	9-40-0	24.2		
6	9-42-0	24.1	8.10	43.28

July 23, 1925

rifice # 76
emp water 74.5°F

Run #	Time: Hr-min-sec: Stop watch # 5	Head #/□" Crosby 818446	Water column: inches	Weight water and can lbs. 28x36268
		0	5.00	
	4-10-0	104.5	7.80	5.20
	4-12-0	104.0		
	4-14-0	104.4		
	4-16-0	105.0		
	4-18-0	105.5		
	4-20-0	104.6	7.95	
	4-22-0	104.2		
	4-24-0	104.0		
	4-26-0	104.1		
	4-28-0	104.2		
	4-30-0	104.4	8.10	19.6
	4-32-0	104.0		
	4-34-04	104.0		
	4-36-0	105.0		
	4-38-0	104.3		
	4-40-0	104.2	8.25	
	4-42-0	104.5		
18	4-44-0	104.5		
19	4-46-0	104.1		
20	4-48-0	104.0		
21	4-50-0	103.5	8.50	34.1
22	4-52-0	103.8	5	
23	4-54-0	104.0		
24	4-56 -0	104.0		
25	4-58-0	104.5		
26	5- 0-0	104.0	8.65	
27	5-02-0	103.5		
28	5-04-0	103.0		
29	5-06-0	104.5		
30	5-08-0	104.0		
31	5-10-0	104.0	10.00	48.58

July 27, 1925

Orifice used #68
Temp. water 73°F

Run #	Time: hr-min-sec: Stop watch #5	Head #/□" Crosby 686317	Water column: inches	Weight water and can lbs. 28x36268
		0	5.00	
1	9-48-0	24.0	7.75	5.20
2	9-50-0	24.0		
3	9-52-0	24.0		
4	9-54-0	24.0		
5	9-56-0	24.0		
6	9-58-0	24.4	7.78	12.90
7	10- 0-0	24.3		
8	10-02-0	24.4		
9	10-04-0	24.3		
10	10-06-0	24.2		
11	10-08-0	24.4	7.80	20.60
12	10-10-0	24.0		
13	10-12-0	24.0		
14	10-14-0	24.0		
15	10-16-0	23.9		
16	10-18-0	23.7		28.30
17	10-20-0	23.5		
18	10-2260	24.0		
19	10-24-0	23.8		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES.

Howell, R. S.
July 27, 1925.

rifice used #68
emp. water 73°F

Run #	Time hr-min-sec Stop watch #5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. 28x36268
	0	5.00		
	10-26-0	23.5		
	10-28-0	23.5	7.80	35.90
	10-30-0	23.3		
	10-32-0	23.6		
	10-34-0	24.0		
	10-36-0	24.0		
	10-38-0	24.0	7.85	43.60
	10-40-0	23.8		
	10-42-0	24.2		
	10-44-0	24.5	7.90	48.20
	10-54-0	35.4	7.60	5.2
	10-56-0	35.2		
	10-58-0	35.4		
	11- 0-0	35.5		
	11-02-0	35.5		
	11-04-0	35.5	7.62	14.50
	11-06-0	35.4		
	11-08-0	35.8		
	11-10-0	35.4		
	11-12-0	36.0		
	11-14-0	35.9	7.66	23.85
	11-16-0	35.9		
	11-18-0	35.9		
	11-20-0	35.5		
	11-22-0	35.8		
	11-24-0	35.7	7.70	33.35
	11-26-0	35.7		
	11-28-0	36.0		
	11-30-0	35.6		
	11-32-0	36.3		
	11-34-0	36.1	7.80	42.70
	11-36-0	35.5		
	11-38-0	34.0		
	11-40-0	34.0		
	11-42-0	33.9	7.80	49.28
	11-54-0	45.2	8.1	5.20
	11-56-0	45.5		
	11-58-0	45.6		
	12- 0-0	45.7		
	12-02-0	45.6		
	12-04-0	45.4	8.20	15.70
	12-06-0	45.5		
	12-08-0	46.1		
63	12-10-0	45.4		
64	12-12-0	45.3		
65	12-14-0	45.0	8.30	26.25
66	12-16-0	45.2		
67	12-18-0	45.3		
68	12-20-0	45.8		
69	12-22-0	45.6		
70	12-24-0	45.8	8.40	36.80
71	12-26-0	45.8		
72	12-28-0	45.7		
73	12-30-0	45.6		
74	12-33-0	45.5		
75	12-34-0	45.4		
76	12-35-0	45.9	8.50	48.5

Temp. water 74°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
77	2-12-0	55.0	7.9	21.35
78	2-14-0	56.0		
79	2-16-0	55.5		
80	2-18-0	55.4		
81	2-20-0	55.4		
82	2-22-0	55.4	7.9	33.00
82	2-24-0	56.1		
83	2-26-0	55.8		
84	2-28-0	55.4		
85	2-30-0	55.0		
86	2-32-0	55.0	7.9	44.65
87	2-34-0	55.6		
88	2-36-0	55.2		
89	2-38-0	55.2		
90	2-40-0	55.0		
91	2-42-0	55.5	7.9	56.30
92	2-44-0	55.5		
93	2-46-0	55.4		
94	2-48-0	56.0		
95	2-50-0	55.0		
96	2-52-0	55.6	7.9	67.95
97	2-54-0	55.4		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

rifice used # 68 — Howell, R. S.
uly 27, 1925.

un #	Time hr-min-sec Stop watch #5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch #5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
	0	5.00				0	5.00		
							July 28, 1925		
3	2-56-0	54.5							
9	2-58-0	56.0			Orifice used #.68				
00	3-0-0	56.0			Temp. water 73°F				
01	3-02-0	55.8	7.95	79.60	1	8-02-0	74.0		
02	3-04-0	55.5			2	8-04-0	73.2		
03	3-06-0	55.0			3	8-06-0	74.8		
04	3-08-0	54.9			4	8-08-0	74.5		
05	3-10-0	55.1			5	8-10-0	75.0		
06	3-12-0	55.3	8.00	91.26	6	8-12-0	74.9	7.65	34.80
07	3-20-0	65.1	8.05	21.35	7	8-14-0	75.0		
08	3-22-0	65.1			8	8-16-0	74.8		
09	3-24-0	64.9			9	8-18-0	74.9		
10	3-26-0	65.0			10	8-20-0	74.4		
11	3-28-0	65.2			11	8-22-0	74.2	7.70	48.30
12	3-30-0	65.0	8.10	33.90	12	8-24-0	75.0		
13	3-32-0	65.1			13	8-26-0	75.0		
14	3-34-0	66.0			14	8-28-0	74.6		
15	3-36-0	65.8			15	8-30-0	74.2		
16	3-38-0	66.0			16	8-32-0	74.1	7.70	61.75
17	3-40-0	65.9	8.15	46.50	17	8-34-0	74.2		
18	3-42-0	66.0			18	8-36-0	74.5		
19	3-44-0	65.0			19	8-38-0	74.2		
20	3-46-0	66.0			20	8-40-0	73.8		
21	3-48-0	65.0			21	8-42-0	74.2	7.70	75.25
22	3-50-0	65.4	8.15	59.10	22	8-44-0	74.5		
23	3-52-0	65.1			23	8-46-0	74.8		
24	3-54-0	63.5			24	8-48-0	74.5		
25	3-56-0	67.0			25	8-50-0	74.8		
26	3-58-0	66.0			26	8-52-0	74.0	7.70	88.70
27	4-0-0	65.5	8.20	71.75	27	8-54-0	73.5		
28	4-02-0	65.1			28	8-56-0	73.4		
29	4-04-0	64.9			29	8-58-0	73.3		
30	4-06-0	64.8			30	9-0-0	73.5		
31	4-08-0	65.5			31	9-02-0	72.2	7.70	102.20
32	4-10-0	65.1	8.20	84.4	32	9-14-0	84.6	7.50	21.35
33	4-12-0	65.5			33	9-16-0	84.1		
34	4-14-0	66.0			34	9-18-0	83.0		
35	4-16-0	65.6			35	9-20-0	83.8		
36	4-18-0	65.1			36	9-22-0	83.2		
37	4-20-0	65.4	8.20	97.20	37	9-24-0	83.5	7.58	35.60

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 28, 1925

rifice # 68
emp. water 73°F.

un: #	Time hr-min-sec: Stop watch: # 5	Head #/□" Crosby: 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run: #	Time hr-min-sec: Stop watch: #5	Head #/□" Crosby: 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
	0	5.00				0	5.00		
3	9-26-0	84.1			82	11-04-0	94.4		
9	9-28-0	84.1			83	11-06-0	94.4	8.15	81.80
0	9-30-0	83.9			84	11-08-0	94.5		
	9-32-0	83.6			85	11-10-0	94.0		
2	9-34-0	83.9	7.60	49.85	86	11-12-0	93.5		
5	9-36-0	83.6			87	11-14-0	93.8		
4	9-38-0	83.9			88	11-16-0	93.8	8.18	96.90
5	9-40-0	84.0			89	11-18-0	94.0		
6	9-42-0	81.0			90	11-20-0	93.6		
7	9-44-0	85.0	7.65	64.10	91	11-22-0	93.8		
8	9-46-0	85.0			92	11-24-0	94.5		
9	9-48-0	85.0			93	11-26-0	95.0	8.20	112.25
0	9-50-0	84.8			94	11-44-0	104.6	7.70	21.35
	9-52-0	84.6			95	11-46-0	104.4		
	9-54-0	84.0	7.68	78.45	96	11-48-0	103.6		
	9-56-0	84.1			97	11-50-0	103.4		
	9-58-0	84.3			98	11-52-0	104.2		
3	10- 0-0	84.5			99	11-54-0	104.4	7.80	37.25
	10-02-0	84.0			100	11-56-0	104.8		
7	10-04-0	83.5	7.70	92.75	101	11-58-0	104.8		
	10-06-0	84.5			102	12- 0-0	104.7		
	10-08-0	84.0			103	12-02-0	104.6		
	10-10-0	84.5			104	12-04-0	104.4	7.85	53.15
	10-12-0	84.0			105	12-06-0	104.1		
	10-14-0	83.5	7.75	107.35	106	12-08-0	103.6		
	10-26-0	94.5	7.90	21.35	107	12-10-0	103.8		
	10-28-0	94.3			108	12-12-0	104.0		
	10-30-0	94.1			109	12-14-0	104.5	7.95	69.05
	10-32-0	93.5			110	12-16-0	105.0		
	10-34-0	93.9			111	12-18-0	105.0		
	10-36-0	94.0	7.92	36.45	112	12-30-0	104.1		
	10-38-0	93.9			113	12-22-0	103.7		
	10-40-0	94.0			114	12-24-0	105.0	8.00	85.00
	10-42-0	94.3			115	12-26-0	105.0		
	10-44-0	94.9			116	12-28-0	105.0		
	10-46-0	94.6	7.98	51.55	117	12-30-0	104.0		
	10-48-0	94.4			118	12-32-0	104.2		
	10-50-0	94.0			119	12-34-0	104.3	8.10	100.95
	10-52-0	93.5			120	12-36-0	104.1		
	10-54-0	93.0			121	12-38-0	105.0		
	10-56-0	94.5	8.10	66.65	122	12-40-0	104.6		
	10-58-0	95.0			123	12-42-0	104.6		
	11- 0-0	95.0			124	12-44-0	104.5	8.20	117.05
	11-02-0	94.9							

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

ifice used # 80
mp. water 72°F
July 28, 1925.

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		0	5.00	
5	2-02-0	105.2	7.75	5.20
6	2-04-0	104.1		
7	2-06-0	104.2		
8	2-08-0	104.0		
9	2-10-0	104.0		
0	2-12-0	104.0	7.80	9.90
1	2-14-0	106.0		
2	2-16-0	103.8		
3	2-18-0	105.0		
4	2-20-0	104.8		
5	2-22-0	105.5	7.90	14.7
6	2-24-0	105.5		
7	2-26-0	105.5		
8	2-28-0	105.0		
9	2-30-0	105.5		
0	2-32-0	105.0	8.00	19.50
1	2-34-0	104.5		
2	2-36-0	105.0		
3	2-38-0	103.5		
4	2-40-0	102.8		
5	2-42-0	103.6	8.05	24.30
6	2-44-0	105.0		
7	2-46-0	105.0		
8	2-48-0	104.8		
9	2-50-0	104.2		
0	2-52-0	104.2	8.10	29.10
1	2-54-0	103.5		
2	2-56-0	103.0		
3	2-58-0	103.5		
4	3-0-0	104.0		
5	3-02-0	104.5	8.20	
6	3-04-0	104.5		
7	3-06-0	104.0		
8	3-08-0	104.5		
9	3-10-0	104.5		
0	3-12-0	103.0	8.25	38.62
1	3-36-0	94.1	7.7	5.20
2	3-38-0	93.5		
3	3-40-0	93.8		
4	3-42-0	93.3		
5	3-44-0	94.5		
6	3-46-0	93.8		
167	3-48-0	93.6		
168	3-50-0	94.9		
169	3-52-0	93.8		
170	3-54-0	94.0		
171	3-56-0	94.2	7.75	14.25
172	3-58-0	94.0		
173	4-0-0	94.1		
174	4-02-0	94.0		
175	4-04-0	94.0		
176	4-06-0	94.0		
177	4-08-0	94.0		
178	4-10-0	93.6		
179	4-12-0	94.0		
180	4-14-0	94.6		
181	4-16-0	94.0	7.80	23.35
182	4-18-0	93.8		
183	4-20-0	93.9		
184	4-22-0	95.5		
185	4-24-0	95.5		
186	4-26-0	94.9		
187	4-28-0	95.0		
188	4-30-0	94.7		
189	4-32-0	93.8		
190	4-34-0	94.0		
191	4-36-0	94.0		32.50
192	4-38-0	94.0		
193	4-40-0	94.0		
194	4-42-0	94.0		
195	4-44-0	94.0		
196	4-46-0	94.0		
197	4-48-0	93.8		
198	4-50-0	94.0		
199	4-52-0	94.0		
200	4-54-0	93.4		
201	4-56-0	93.9		
203	4-58-0	94.0		
204	5-0-0	93.6		
205	5-02-0	93.0		
206	5-04-0	93.0		
207	5-06-0	94.0	8.18	46.22

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 22, 1925.

Orifice used # 76
Temp. water 72°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches mercury Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches 5.00	Weight water and can lbs 28x36268
1	9-0-0	14.05	13.55	27.60	6.50	5.18
2	9-02-0	14.00	13.50	27.50		
3	9-04-0	14.00	13.50	27.50		
4	9-06-0	14.00	13.50	27.50		
5	9-08-0	13.95	13.45	27.40		
6	9-10-0	14.00	13.50	27.50	6.55	
7	9-12-0	14.00	13.50	27.50		
8	9-14-0	13.80	13.35	27.15		
9	9-16-0	13.90	13.45	27.35		
10	9-18-0	13.95	13.48	27.43		
11	9-20-0	14.00	13.50	27.50		
12	9-22-0	14.00	13.50	27.50		
13	9-24-0	13.95	13.46	27.41		
14	9-26-0	13.95	13.46	27.41		
15	9-28-0	14.00	13.50	27.50		
16	9-30-0	14.00	13.50	27.50	6.65	
17	9-32-0	13.90	13.40	27.30		
18	9-34-0	14.10	13.65	27.75		
19	9-36-0	14.15	13.68	27.83		
20	9-38-0	13.75	13.30	27.05		
21	9-40-0	14.10	13.60	27.70	6.68	
22	9-42-0	14.30	13.80	28.10		
23	9-44-0	14.10	13.60	27.70		
24	9-46-0	14.00	13.50	27.50		
25	9-48-0	14.05	13.55	27.60		
26	9-50-0	14.00	13.50	27.50	6.68	
27	9-52-0	13.90	13.40	27.30		
28	9-54-0	14.05	13.55	27.60		
29	9-56-0	14.05	13.55	27.60		
30	9-58-0	14.00	13.50	27.50		
31	10-0-0	14.00	13.50	27.50	6.70	
32	10-02-0	14.00	13.50	27.50		
33	10-04-0	13.95	13.46	27.41		
34	10-06-0	14.00	13.50	27.50		
35	10-08-0	14.05	13.55	27.60		
36	10-10-0	14.10	13.60	27.70	6.70	
37	10-12-0	13.95	13.46	27.41		
38	10-14-0	14.05	13.55	27.60		
39	10-16-0	14.05	13.55	27.60		
40	10-18-0	14.05	13.55	27.60		
41	10-20-0	14.05	13.55	27.60	6.72	
42	10-22-0	14.00	13.50	27.50		
43	10-24-0	14.00	13.50	27.50		
44	10-26-0	13.85	13.30	27.15		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 76
Temp. water 72° F

Howell, R. S.
July 22, 1925/

Run #	Time hr-min-sec. Stop watch # 5	Manometer Reading Left	Right	Total inches mercury Meriam Company Cleveland, Ohio	Water column inches	Weight water and can lbs. 28x36268
		0	0	0	5,00	
45	10-28-0	14.10	13.60	27.70		
46	10-30-0	14.20	13.70	27.90	6.75	
47	10-32-0	14.20	13.70	27.90		
48	10-34-0	14.10	13.60	27.70		
49	10-36-0	14.10	13.60	27.70		
50	10-38-0	14.05	13.55	27.60		
51	10-40-0	14.05	13.55	27.60	6.75	
52	10-42-0	14.10	13.60	27.70		
53	10-44-0	14.10	13.60	27.70		
54	10-46-0	14.10	13.60	27.70		
55	10-48-0	14.05	13.55	27.60		
56	10-50-0	14.10	13.60	27.70	6.78	
57	10-52-0	14.10	13.60	27.70		
58	10-54-0	14.10	13.60	27.70		
59	10-56-0	14.10	13.60	27.70		
60	10-58-0	14.10	13.60	27.70		
61	11- 0-0	14.00	13.50	27.50	6.80	37.85
62	11-18-0	9.00	8.80	17.80	6.5	5.18
63	11-20-0	8.95	8.75	17.70		
64	11-22-0	8.90	8,70	17.60		
65	11-24-0	8.90	8.70	17.60		
66	11-26-0	8.90	8,70	17.60		
67	11-28-0	8.95	8.75	17.70	6.5	
68	11-30-0	9.00	8.80	17.80		
69	11-32-0	9.00	8.80	17.80		
70	11-34-0	9.00	8.80	17.80		
71	11-36-0	8.90	8.70	17.60		
72	11-38-0	8.85	8.65	17.50	6.5	
73	11-40-0	9.10	8.90	18.00		
74	11-42-0	9.00	8.80	17.80		
75	11-44-0	8.95	8.75	17.70		
76	11-46-0	9.05	8,85	17.90		
77	11-48-0	9.05	8.85	17.90		
78	11-50-0	9.00	8.80	17.80		
79	11-52-0	9.00	8.80	17.80		
80	11-54-0	8.95	8.75	17.70		
81	11-56-0	8.95	8.75	17.70		
82	11-58-0	9.00	8.80	17.80	6.55	
83	12- 0-0	9.00	8.80	17.80		
84	12-02-0	9.05	8.85	17.90		
85	12-04-0	9.00	8.80	17.80		
86	12-06-0	9.05	8.85	17.90		
87	12-08-0	9.05	8.85	17.90	6.55	
88	12-10-0	9.00	8.80	17.80		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 22, 1925

Orifice used # 76
Temp. water 72 °F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches mercury Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches	Weight water and can lbs. 28x36268
		0	0	0	5.00	
89	12-12-0	9.00	8.80	17.80		
90	12-14-0	9.00	8.80	17.80		
91	12-16-0	9.05	8.85	17.90		
92	12-18-0	9.05	8.85	17.90	6.60	
93	12-20-0	9.00	8.80	17.80		
94	12-22-0	9.00	8.80	17.80		
95	12-24-0	9.00	8.80	17.80		
96	12-26-0	9.00	8.80	17.80		
97	12-28-0	9.00	8.80	17.80	6.60	
98	12-30-0	9.00	8.80	17.80		
99	12-32-0	9.00	8.80	17.80		
100	12-34-0	9.00	8.80	17.80		
101	12-36-0	9.00	8.80	17.80		
102	12-38-0	8.90	8.70	17.60	6.60	
103	12-40-0	8.80	8.60	17.40		
104	12-42-0	8.80	8.60	17.40		
105	12-44-0	9.10	8.90	18.00		
106	12-46-0	9.15	8.95	18.10		
107	12-48-0	9.05	8.85	17.90	6.60	
108	12-50-0	9.05	8.85	17.90		
109	12-52-0	9.00	8.80	17.80		
110	12-54-0	8.95	8.75	17.70		
111	12-56-0	9.00	8.80	17.80		
112	12-58-0	9.00	8.80	17.80	6.60	
113	1- 0-0	9.00	8.80	17.80		
114	1-02-0	9.00	8.80	17.80		
115	1-04-0	8.95	8.75	17.70		
116	1-06-0	8.95	8.75	17.70		
117	1-08-0	8.95	8.75	17.70	6.60	
118	1-10-0	8.98	8.78	17.76		
119	1-12-0	9.00	8.80	17.80		
120	1-14-0	9.00	8.80	17.80		
121	1-16-0	8.95	8.75	17.70		
122	1-18-0	8.95	8.75	17.70	6.60	
123	1-20-0	9.05	8.85	17.70		
124	1-22-0	9.05	8.85	17.70		
125	1-24-0	9.02	8.82	17.84		
126	1-26-0	9.02	8.82	17.84		
127	1-28-0	9.00	8.80	17.80	6.65	
128	1-30-0	9.00	8.80	17.80		
129	1-32-0	9.00	8.80	17.80		
130	1-34-0	9.00	8.80	17.80		
131	1-36-0	9.00	8.80	17.80		
132	1-38-0	9.00	8.80	17.80	6.65	

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 22, 1925.

Orifice used # 76
Temp. water 75°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total	Water column inches	Weight water and can lbs. 28x36268
		inches mercury Meriam Company Cleveland, Ohio			5.00	
133	2-05-0	4.63	4.55	9.17	6.85	5.18
134	2-07-0	4.60	4.50	9.10		
135	2-09-0	4.62	4.52	9.14		
136	2-11-0	4.62	4.52	9.14		
137	2-13-0	4.75	4.70	9.45		
138	2-15-0	4.75	4.70	9.45	6.85	
139	2-17-0	4.70	4.65	9.35		
140	2-19-0	4.70	4.65	9.35		
141	2-21-0	4.70	4.65	9.35		
142	2-23-0	4.70	4.65	9.35		
143	2-25-0	4.70	4.65	9.35	6.88	
144	2-27-0	4.65	4.58	9.23		
145	2-29-0	4.62	4.55	9.17		
146	2-31-0	4.55	4.48	9.03		
147	2-33-0	4.54	4.47	9.01		
148	2-35-0	4.55	4.48	9.03	6.90	
149	2-37-0	4.55	4.48	9.03		
150	2-39-0	4.55	4.48	9.03		
151	2-41-0	4.55	4.47	9.02		
152	2-43-0	4.53	4.45	8.98		
153	2-45-0	4.52	4.44	8.96	6.90	
154	2-47-0	4.52	4.45	8.97		
155	2-49-0	4.55	4.48	9.03		
156	2-51-0	4.55	4.48	9.03		
157	2-53-0	4.52	4.45	8.97		
158	2-55-0	4.49	4.42	8.91	6.92	
159	2-57-0	4.52	4.45	8.97		
160	2-59-0	4.52	4.45	8.97		
161	3-01-0	4.57	4.50	9.07		
162	3-03-0	4.62	4.55	9.15		
163	3-05-0	4.69	4.62	9.31	6.95	
164	3-07-0	4/57	4.50	9.07		
165	3-09-0	4.62	4.55	7.17		
166	3-11-0	4.67	4.60	9.27		
167	3-13-0	4.77	4.70	9.47		
168	3-15-0	4.69	4.52	9.21	6.95	
169	3-17-0	4.69	4.60	9.27		
170	3-19-0	4.69	4.52	9.11		
171	3-21-0	4.55	4.48	9.03		
172	3-23-0	4.58	4.51	9.19		
173	3-25-0	4.49	4.42	8.91	6.95	
174	3-27-0	4.49	4.42	8.91		
175	3-29-0	4.58	4.51	9.09		
176	3-31-0	4.50	4.43	8.93		
177	3-33-0	4.47	4.40	8.87		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 76
Temp. water 75° F

Howell, R. S.
July 22, 1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total inches mercury Meriam Company Cleveland, Ohio	Water column inches	Weight water and can lbs. 28x36268
178	3-35-0	0	0	0	5.00	
179	3-37-0	4.53	4.46	8.99	6.95	
180	3-39-0	4.53	4.46	8.99		
181	3-41-0	4.59	4.52	9.11		
182	3-43-0	4.72	4.65	9.37		
183	3-45-0	4.62	4.55	9.17		
184	3-47-0	4.57	4.50	9.07	6.95	
185	3-49-0	4.60	4.52	9.12		
186	3-51-0	4.60	4.52	9.12		
187	3-53-0	4.70	4.62	9.32		
188	3-55-0	4.60	4.52	9.12		
189	3-57-0	4.60	4.51	9.11	6.95	
190	3-59-0	4.60	4.51	9.11		
191	4-01-0	4.63	4.55	9.18		
192	4-03-0	4.63	4.55	9.18		
193	4-05-0	4.76	4.68	9.44		
194	4-07-0	4.66	4.58	9.24		
195	4-09-0	4.50	4.42	8.92		
196	4-11-0	4.50	4.42	8.92		
197	4-13-0	4.50	4.41	8.91		
198	4-15-0	4.50	4.41	8.91		
199	4-17-0	4.58	4.49	9.07		
200	4-19-0	4.58	4.49	9.07		
201	4-21-0	4.58	4.49	9.07		
202	4-23-0	4.59	4.50	9.09		
203	4-25-0	4.46	4.56	9.20		
204	4-27-0	4.74	4.66	9.40	6.98	
205	4-29-0	4.62	4.54	9.16		
206	4-31-0	4.78	4.70	9.48		
207	4-33-0	4.75	4.67	9.42		
208	4-35-0	4.76	4.68	9.44		
209	4-37-0	4.76	4.68	9.44	6.98	
210	4-39-0	4.75	4.67	9.44		
211	4-41-0	4.70	4.62	9.32		
212	4-43-0	4.60	4.52	9.12		
213	4-45-0	4.59	4.51	9.10		
214	4-47-0	4.62	4.54	9.16	6.98	
215	4-49-0	4.60	4.52	9.12		
216	4-51-0	4.60	4.52	9.12		
217	4-53-0	4.60	4.52	9.12		
218	4-55-0	4.55	4.47	9.02		
219	4-57-0	4.51	4.43	8.94	7.00	
220	4-59-0	4.58	4.50	9.08		
221	5-01-0	4.59	4.51	9.10		
222	5-03-0	4.70	4.72	9.42		
223	5-05-0	4.71	4.73	9.44		
		4.61	4.63	9.34	7.00	35.8

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 76
Temp. water 73°F

Howell, R. S.
July 23, 1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches mercury Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches	Weight water and can lbs. 28x36268
		0	0	0	5.00	
1	9- 0-0	1.85	1.81	3.66	6.90	5.18
2	9-02-0	1.85	1.81	3.66		
3	9-04-0	1.84	1.80	3.64		
4	9-06-0	1.82	1.78	3.60		
5	9-08-0	1.80	1.76	3.56		
6	9-10-0	1.80	1.76	3.56		
7	9-12-0	1.80	1.76	3.56		
8	9-14-0	1.80	1.76	3.56		
9	9-16-0	1.80	1.76	3.56		
10	9-18-0	1.80	1.76	3.56		
11	9-20-0	1.79	1.75	3.54	6.90	
12	9-22-0	1.79	1.75	3.54		
13	9-24-0	1.79	1.75	3.54		
14	9-26-0	1.78	1.74	3.52		
15	9-28-0	1.78	1.74	3.52		
16	9-30-0	1.78	1.74	3.52		
17	9-32-0	1.78	1.74	3.52		
18	9-34-0	1.78	1.74	3.52		
19	9-36-0	1.78	1.74	3.52		
20	9-38-0	1.78	1.74	3.52		
21	9-40-0	1.78	1.74	3.52	6.90	
22	9-42-0	1.78	1.74	3.52		
23	9-44-0	1.78	1.74	3.52		
24	9-46-0	1.78	1.74	3.52		
25	9-48-0	1.78	1.74	3.52		
26	9-50-0	1.78	1.74	3.52		
27	9-52-0	1.78	1.74	3.52		
28	9-54-0	1.78	1.74	3.52		
29	9-56-0	1.78	1.74	3.52		
30	9-58-0	1.77	1.73	3.50		
31	10- 0-0	1.76	1.72	3.48	6.90	
32	10-02-0	1.74	1.70	3.44		
33	10-04-0	1.74	1.70	3.44		
34	10-06-0	1.74	1.70	3.44		
35	10-08-0	1.74	1.70	3.44		
36	10-10-0	1.74	1.70	3.44		
37	10-12-0	1.75	1.71	3.46		
38	10-14-0	1.78	1.74	3.52		
39	10-16-0	1.79	1.75	3.54		
40	10-18-0	1.79	1.75	3.54		
41	10-20-0	1.79	1.75	3.54	6.90	
42	10-22-0	1.79	1.75	3.54		
43	10-24-0	1.79	1.75	3.54		
44	10-26-0	1.79	1.75	3.54	6.90	

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 23, 1925

Orifice used # 76
Temp. water 73°F

Run #	Time Hr-min-sec Stop watch # 5	Manometer Reading inches mercury Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches	Weight water and can lbs. 28x36268
		0	0	0	5.00	
45	10-28-0	1.79	1.75	3.54		
46	10-30-0	1.79	1.75	3.54		
47	10-32-0	1.79	1.75	3.54		
48	10-34-0	1.79	1.75	3.54		
49	10-36-0	1.79	1.75	3.54		
50	10-38-0	1.79	1.75	3.54		
51	10-40-0	1.79	1.75	3.54	6.90	
52	10-42-0	1.79	1.75	3.54		
53	10-44-0	1.79	1.75	3.54		
54	10-46-0	1.79	1.75	3.54		
55	10-48-0	1.79	1.75	3.54		
56	10-50-0	1.79	1.75	3.54		
57	10-52-0	1.79	1.75	3.54		
58	10-54-0	1.78	1.74	3.52		
59	10-56-0	1.78	1.74	3.52		
60	10-58-0	1.78	1.74	3.52		
61	11- 0-0	1.78	1.74	3.52	6.90	
62	11-02-0	1.78	1.74	3.52		
63	11-04-0	1.78	1.74	3.52		
64	11-06-0	1.78	1.74	3.52		
65	11-08-0	1.78	1.74	3.52		
66	11-10-0	1.78	1.74	3.52		
67	11-12-0	1.78	1.74	3.52		
68	11-14-0	1.78	1.74	3.52		
69	11-16-0	1.76	1.72	3.48		
70	11-18-0	1.78	1.74	3.52		
71	11-20-0	1.80	1.76	3.56	6.90	
72	11-22-0	1.82	1.78	3.60		
73	11-24-0	1.84	1.80	3.64		
74	11-26-0	1.85	1.81	3.66		
75	11-28-0	1.87	1.83	3.70		
76	11-30-0	1.90	1.86	3.76		
77	11-32-0	1.91	1.87	3.78		
78	11-34-0	1.92	1.88	3.80		
79	11-36-0	1.92	1.88	3.80		
80	11-38-0	1.92	1.88	3.80		
81	11-40-0	1.92	1.88	3.80	6.90	
82	11-42-0	1.92	1.88	3.80		
83	11-44-0	1.92	1.88	3.80		
84	11-46-0	1.92	1.88	3.80		
85	11-48-0	1.92	1.88	3.80		
86	11-50-0	1.92	1.88	3.80		
87	11-52-0	1.92	1.88	3.80		
88	11-54 -0	1.92	1.88	3.80		
89	11-56-0	1.92	1.88	3.80		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 23, 1925

Orifice used # 76
Temp. water 73°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total (inches mercury, Meriam Company, Cleveland, Ohio)	Water column inches	Weight water and can lbs. 28x36268
		0	0	0	5.00	
90	11-58-0	1.92	1.88	3.80		
91	12- 0-0	1.92	1.88	3.80	6.90	
92	12-02-0	1.92	1.88	3.80		
93	12-04-0	1.92	1.88	3.80		
94	12-06-0	1.92	1.88	3.80		
95	12-08-0	1.92	1.88	3.80		
96	12-10-0	1.92	1.88	3.80		
97	12-12-0	1.92	1.88	3.80		
98	12-14-0	1.92	1.88	3.80		
99	12-16-0	1.92	1.88	3.80		
100	12-18-0	1.92	1.88	3.80		
101	12-20-0	1.92	1.88	3.80	6.90	
102	12-22-0	1.92	1.88	3.80		
103	12-24-0	1.92	1.88	3.80		
104	12-26-0	1.92	1.88	3.80		
105	12-28-0	1.93	1.89	3.82		
106	12-30-0	1.95	1.91	3.86		
107	12-32-0	1.97	1.93	3.90		
108	12-34-0	1.98	1.94	3.92		
109	12-36-0	2.00	1.96	3.96		
110	12-38-0	1.88	1.84	3.72		
111	12-40-0	1.75	1.71	3.46	6.90	
112	12-42-0	1.65	1.61	3.26		
113	12-44-0	1.90	1.86	3.76		
114	12-46-0	1.95	1.91	3.86		
115	12-48-0	2.00	1.96	3.96		
116	12-50-0	2.02	1.98	4.00		
117	12-52-0	2.02	1.98	4.00		
118	12-54-0	2.00	1.96	3.96		
119	12-56-0	2.00	1.96	3.96		
120	12-58-0	1.99	1.95	3.94		
121	1 - 0-0	1.99	1.95	3.94	6.90	
122	1-04-0	1.99	1.95	3.94		
123	1-08-0	1.99	1.95	3.94		
124	1-12-0	2.00	1.96	3.96		
125	1-16-0	1.92	1.88	3.80		
126	1-30-0	1.88	1.84	3.72	6.90	
127	1-34-0	1.85	1.81	3.66		
128	1-38-0	1.85	1.81	3.66		
129	1-32-0	1.85	1.81	3.66		
130	1-36-0	1.85	1.81	3.66		
131	1-40-0	1.85	1.81	3.66	6.90	
132	1-44-0	1.85	1.81	3.66		
133	1-48-0	1.85	1.81	3.66		
134	1-52-0	1.85	1.81	3.66		
135	1-56-0	1.85	1.81	3.66		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 76
Temp. Water 73°F
July 23, 1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total	Water column inches	Weight water and can lbs. 28x36268
		inches mercury Meriam Company Cleveland, Ohio				
		0	0	0	5.00	
136	2-0-0	1.85	1.81	3.66	6.90	
137	2-04-0	1.86	1.82	3.68		
138	2-08-0	1.78	1.74	3.52		
139	2-12-0	1.76	1.72	3.48		
140	2-16-0	1.80	1.76	3.56		
141	2-20-0	1.80	1.76	3.56	6.90	43.22

July 24, 1925

Orifice used # 68
Temp. water 74.5°F

		feet of water		Diff.		
1	1-04-0	0.35	3.35	3.00	7.4	5.20
2	1-08-0	0.35	3.35	3.00		
3	1-12-0	0.35	3.45	3.10		
4	1-16-0	0.35	3.47	3.12		
5	1-20-0	0.35	3.43	3.08		
6	1-24-0	0.35	3.41	3.06		
7	1-28-0	0.35	3.39	3.04		
8	1-32-0	0.35	3.35	3.00		
9	1-36-0	0.35	3.30	2.95		
10	1-40-0	0.35	3.39	3.04		
11	1-44-0	0.35	3.43	3.08	7.4	14.50
12	1-48-0	0.35	3.44	3.09		
13	1-52-0	0.35	3.43	3.08		
14	1-56-0	0.35	3.42	3.07		
15	2-0-0	0.35	3.38	3.03		
16	2-04-0	0.35	3.36	3.01		
17	2-08-0	0.35	3.50	3.15		
18	2-12-0	0.35	3.55	3.20		
19	2-16-0	0.35	3.56	3.21		
20	2-20-0	0.35	3.55	3.20		
21	2-24-0	0.35	3.54	3.19	7.4	23.85
22	2-28-0	0.35	3.53	3.18		
23	2-32-0	0.35	3.52	3.17		
24	2-36-0	0.35	3.50	3.15		
25	2-40-0	0.35	3.48	3.13		
26	2-44-0	0.35	3.46	3.11		
27	2-48-0	0.35	3.46	3.11		
28	2-52-0	0.35	3.45	3.10		
29	2-56-0	0.35	3.44	3.09		
30	3-0-0	0.35	3.43	3.08		
31	3-04-0	0.35	3.42	3.07	7.38	33.30
32	3-08-0	0.35	3.40	3.05		
33	3-12-0	0.35	3.38	3.03		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 24, 1925

Orifice used # 68
Temp. water 74.5°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total (inches mercury, Meriam Company, Cleveland, Ohio)	Water column inches	Weight water and can lbs. 28x36268
		0 (Zero of Scale)	0	Diff.	5.00	
34	3-16-0	0.35	3.45	3.10		
35	3-20-0	0.35	3.58	3.23		
36	3-24-0	0.35	3.62	3.27		
37	3-28-0	0.35	3.63	3.28		
38	3-32-0	0.35	3.63	3.28		
39	3-36-0	0.35	3.62	3.27		
40	3-40-0	0.35	3.61	3.26		
41	3-44-0	0.35	3.58	3.23	7.35	42.80
42	3-48-0	0.35	3.56	3.21		
43	3-52-0	0.35	3.55	3.20		
44	3-56-0	0.35	3.53	3.18		
45	4- 0-0	0.35	3.52	3.17		
46	4-04-0	0.35	3.51	3.16	7.35	47.62

July 25, 1925

Orifice used # 68
Temp. water 73.5°F

		Inches of Hg		Total		
1	8-26-0	4.59	4.51	9.10	6.40	5.20
2	8-28-0	4.59	4.51	9.10		
3	8-30-0	4.60	4.52	9.12		
4	8-32-0	4.61	4.53	9.14		
5	8-34-0	4.61	4.53	9.14		
6	8-36-0	4.61	4.53	9.14		
7	8-38-0	4.60	4.52	9.12		
8	8-40-0	4.60	4.52	9.12		
9	8-42-0	4.58	4.50	9.08		
10	8-44-0	4.51	4.43	8.94		
11	8-46-0	4.51	4.43	8.94	6.40	12.30
12	8-48-0	4.51	4.43	8.94		
13	8-50-0	4.51	4.43	8.94		
14	8-52-0	4.51	4.43	8.94		
15	8-54-0	4.50	4.42	8.92		
16	8-56-0	4.49	4.41	8.90		
17	8-58-0	4.50	4.42	8.92		
18	9- 0-0	4.59	4.51	9.10		
19	9-02-0	4.68	4.60	9.28		
20	9-04-0	4.70	4.62	9.32		
21	9-06-0	4.70	4.62	9.32	6.40	19.50
22	9-08-0	4.71	4.63	9.34		
23	9-10-0	4.71	4.63	9.34		
24	9-12-0	4.72	4.64	9.36		
25	9-14-0	4.71	4.63	9.34		
26	9-16-0	4.71	4.63	9.34		
27	9-18-0	4.70	4.62	9.32		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 25, 1925

Orifice used # 68
Temp. water 73.5°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total	Water column inches	Weight water and can lbs. 28x36268
		inches mercury Meriam Company Cleveland, Ohio				
		0	0	0	5.00	
28	9-20-0	4.70	4.62	9.32		
29	9-22-0	4.70	4.62	9.32		
30	9-24-0	4.70	4.62	9.32		
31	9-26-0	4.70	4.62	9.32	6.40	26.70
32	9-28-0	4.70	4.62	9.32		
33	9-30-0	4.69	4.61	9.30		
34	9-32-0	4.69	4.61	9.30		
35	9-34-0	4.69	4.61	9.30		
36	9-36-0	4.69	4.61	9.30		
37	9-38-0	4.68	4.60	9.28		
38	9-40-0	4.68	4.60	9.28		
39	9-42-0	4.68	4.60	9.28		
40	9-44-0	4.68	4.60	9.28		
41	9-46-0	4.68	4.60	9.28	6.40	33.95
42	9-48-0	4.65	4.57	9.22		
43	9-50-0	4.64	4.56	9.20		
44	9-52-0	4.63	4.55	9.18		
45	9-54-0	4.61	4.53	9.14		
46	9-56-0	4.60	4.52	9.12		
47	9-58-0	4.60	4.52	9.12		
48	10- 0-0	4.60	4.52	9.12		
49	10-02-0	4.59	4.51	9.10		
50	10-04-0	4.59	4.51	9.10		
51	10-06-0	4.59	4.51	9.10	6.40	41.15
52	10-08-0	4.59	4.51	9.10		
53	10-10-0	4.58	4.50	9.08		
54	10-12-0	4.56	4.48	9.04		
55	10-14-0	4.55	4.47	9.02		
56	10-16-0	4.54	4.46	9.00		
57	10-18-0	4.54	4.46	9.00		
58	10-20-0	4.54	4.46	9.00		
59	10-22-0	4.54	4.46	9.00		
60	10-24-0	4.54	4.46	9.00		
61	10-26-0	4.53	4.45	8.98	6.40	48.40
		Temp. water 75°F				
62	10-46-0	8.72	8.52	17.24	6.8	5.20
63	10-48-0	8.72	8.52	17.24		
64	10-50-0	8.72	8.52	17.24		
65	10-52-0	8.72	8.52	17.24		
66	10-54-0	8.72	8.52	17.24		
67	10-56-0	8.71	8.51	17.22		
68	10-58-0	8.71	8.51	17.22		
69	11- 0-0	8.71	8.51	17.22		
70	11-02-0	8.70	8.50	17.20		
71	11-04-0	8.70	8.50	17.20		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 25, 1925

Orifice used # 68
Temp. water 75°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches mercury Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		0	0	0	5.00	
72	11-06-0	8.70	8.50	17.20	6.8	14.80
73	11-08-0	8.70	8.50	17.20		
74	11-10-0	8.70	8.50	17.20		
75	11-12-0	8.69	8.49	17.18		
76	11-14-0	8.69	8.49	17.18		
77	11-16-0	8.68	8.48	17.16		
78	11-18-0	8.67	8.47	17.14		
79	11-20-0	8.66	8.46	17.12		
80	11-22-0	8.65	8.45	17.10		
81	11-24-0	8.64	8.44	17.08		
82	11-26-0	8.62	8.42	17.04	6.80	24.40
83	11-28-0	8.62	8.42	17.04		
84	11-30-0	8.62	8.42	17.04		
85	11-32-0	8.62	8.42	17.04		
86	11-34-0	8.62	8.42	17.04		
87	11-36-0	8.62	8.42	17.04		
88	11-38-0	8.62	8.42	17.04		
89	11-40-0	8.62	8.42	17.04		
90	11-42-0	8.63	8.43	17.06		
91	11-44-0	8.64	8.44	17.08		
92	11-46-0	8.65	8.45	17.10	6.75	34.05
93	11-48-0	8.65	8.45	17.10		
94	11-50-0	8.64	8.44	17.08		
95	11-52-0	8.65	8.45	17.10		
96	11-54-0	8.65	8.45	17.10		
97	11-56-0	8.65	8.45	17.10		
98	11-58-0	8.65	8.45	17.10		
99	12- 0-0	8.65	8.45	17.10		
100	12-02-0	8.65	8.45	17.10		
101	12-04-0	8.65	8.45	17.10		
102	12-06-0	8.64	8.44	17.08	6.75	43.65
103	12-08-0	8.64	8.44	17.08		
104	12-10-0	8.64	8.44	17.08		
105	12-12-0	8.65	8.45	17.10		
106	12-14-0	8.65	8.45	17.10		
107	12-16-0	8.67	8.47	17.14	6.75	48.50

July 27, 1925

Orifice used # 68
Temp. water 73°F

1	8-20-0	14.00	13.50	27.50	7.35	5.20
2	8-22-0	14.00	13.50	27.50		
3	8-24-0	13.91	13.41	27.32		
4	8-26-0	14.01	13.51	27.52		
5	8-28-0	14.01	13.51	27.52		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 27, 1925

Orifice used # 68
Temp. water 73°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches mercury Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		0	0	0	5.00	
6	8-30-0	14.00	13.50	27.50		
7	8-32-0	14.00	13.50	27.50		
8	8-34-0	14.00	13.50	27.50		
9	8-36-0	14.00	13.50	27.50		
10	8-38-0	14.00	13.50	27.50		
11	8-40-0	13.91	13.42	27.43	7.35	17.05
12	8-42-0	14.00	13.50	27.50		
13	8-44-0	13.75	13.30	27.05		
14	8-46-0	13.80	13.32	27.12		
15	8-48-0	13.80	13.32	27.12		
16	8-50-0	13.95	13.47	27.42		
17	8-52-0	13.90	13.40	27.30		
18	8-54-0	13.91	13.42	27.33		
19	8-56-0	13.91	13.42	27.33		
20	8-58-0	13.85	13.40	27.25		
21	9- 0-0	13.98	13.48	27.46	7.35	28.90
22	9-02-0	14.00	13.50	27.50		
23	9-04-0	14.00	13.50	27.50		
24	9-06-0	14.01	13.51	27.52		
25	9-08-0	13.96	13.46	27.42		
26	9-10-0	14.00	13.50	27.50		
27	9-12-0	14.10	13.60	27.70		
28	9-14-0	14.12	13.62	27.74		
29	9-16-0	13.95	13.47	27.42		
30	9-18-0	13.85	13.40	27.25		
31	9-20-0	13.87	13.41	27.28	7.35	40.75
32	9-22-0	13.80	13.30	27.10		
33	9-24-0	13.82	13.32	27.14		
34	9-26-0	13.90	13.40	27.30		
35	9-28-0	13.90	13.40	27.30		
36	9-30-0	13.90	13.40	27.30	7.35	46.68

August 5, 1925

Orifice used # 76
Temp. water 77°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Readings feet of water water column Left	Right	Diff.	Water column inches	Weight water and can lbs. Howe 28x1866
½	12-48-0	0.32	8.26	7.94	8.5	2.70
2	12-50-0	0.32	8.25	7.93		
3	12-52-0	0.32	8.24	7.92		
4	12-54-0	0.32	8.24	7.92		
5	12-56-0	0.32	8.24	9.92		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 5, 1925

Orifice used # 76
Temp. water 77°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading feet of water water column Left	Right	Diff.	Water column inches	Weight water and can lbs Howe 28x1866
6	12-58-0	0.32	8.23	7.91		
7	1- 0-0	0.32	8.23	7.91		
8	1-02-0	0.32	8.23	7.91		
9	1-04-0	0.32	8.24	7.92		
10	1-06-0	0.32	8.23	7.91		
11	1-08-0	0.32	8.22	7.90		
12	1-10-0	0.32	8.22	7.90		
13	1-12-0	0.32	8.22	7.90		
14	1-14-0	0.32	8.23	7.91		
15	1-16-0	0.32	8.24	7.92		
16	1-18-0	0.32	8.25	7.93		
17	1-20-0	0.32	8.25	7.93		
18	1-22-0	0.32	8.24	7.92		
19	1-22-38	0.32	8.23	7.91	8.5	8.47
20	1-33-0	0.32	8.23	7.91	8.45	2.70
21	1-35-0	0.32	8.24	7.92		
22	1-37-0	0.32	8.26	7.94		
23	1-39-0	0.32	8.26	7.94		
24	1-41-0	0.32	8.27	7.95		
25	1-43-0	0.32	8.25	7.93		
26	1-45-0	0.32	8.22	7.90		
27	1-47-0	0.32	8.22	7.90		
28	1-49-0	0.32	8.21	7.89		
29	1-51-0	0.32	8.22	7.90		
30	1-53-0	0.32	8.23	7.91		
31	1-55-0	0.32	8.23	7.91		
32	1-57-0	0.32	8.22	7.90		
33	1-59-0	0.32	8.22	7.90		
34	2-01-0	0.32	8.22	7.90		
35	2-03-0	0.32	8.22	7.90		
36	2-05-0	0.32	8.22	7.90		
37	2-06-44	0.32	8.22	7.90	8.40	8.47
		inches mercury				Fairbanks
		Meriam Company				28x36268
		Cleveland, Ohio				
38	2-36-0	8.70	8.50	17.25 Total	7.95	5.36
39	2-40-0	8.75	8.55	17.30		
40	2-44-0	8.55	8.35	16.90		
41	2-48-0	8.62	8.42	17.04		
42	2-52-0	8.82	8.62	17.44		
43	2-56-0	8.93	8.73	17.66		
44	3- 0-0	8.82	8.62	17.44		
45	3-04-0	8.70	8.50	17.20		
46	3-08-0	8.60	8.40	17.00		
47	3-12-0	8.63	8.43	17.06		
48	3-16-0	8.66	8.46	17.12		
49	3-20-0	8.62	8.42	17.04		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 5, 1925

Orifice used # 76
Temp. water 77°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		inches mercury Meriam Company Cleveland, Ohio				
50	3-24-0	8.64	8.44	17.08		
51	3-28-0	8.62	8.42	17.04		
52	3-32-0	8.66	8.46	17.12		
53	3-36-0	8.68	8.48	17.16	8.00	21.8
54	3-40-0	8.66	8.46	17.12		
55	3-44-0	8.61	8.41	17.02		
56	3-48-0	8.62	8.42	17.04		
57	3-52-0	8.60	8.40	17.00		
58	3-56-0	8.61	8.41	17.02		
59	4-0-0	8.61	8.41	17.02		
60	4-04-0	8.62	8.42	17.04		
61	4-08-0	8.62	8.42	17.04		
62	4-12-0	8.63	8.43	17.06		
63	4-16-0	8.64	8.44	17.08		
64	4-20-0	8.80	8.60	17.40		
65	4-24-0	8.75	8.55	17.30		
66	4-28-0	8.65	8.45	17.10		
67	4-32-0	8.70	8.50	17.20		
68	4-36-0	8.69	8.49	17.18	8.00	37.90
69	4-40-0	8.72	8.52	17.24		
70	4-44-0	8.71	8.51	17.22		
71	4-48-0	8.66	8.46	17.12		
72	4-52-0	8.63	8.43	17.06		
73	4-56-0	8.65	8.45	17.10	8.00	42.50

August 6, 1926

Orifice used # 60
Temp. water 74°F.

		FEET OF WATER water column		Diff.		
1	8-24-0	0.35	4.38	4.03	7.7	5.38
2	8-26-0	0.35	4.47	4.12		
3	8-28-0	0.35	4.48	4.13		
4	8-30-0	0.35	4.47	4.12		
5	8-32-0	0.35	4.42	4.07		
6	8-34-0	0.35	4.38	4.03		
7	8-36-0	0.35	4.35	4.00		
8	8-38-0	0.35	4.40	4.05		
9	8-40-0	0.35	4.47	4.12		
10	8-42-0	0.35	4.47	4.12		
11	8-44-0	0.35	4.43	4.08		
12	8-46-0	0.35	4.46	4.11		
13	8-48-0	0.35	4.43	4.08		
14	8-50-0	0.35	4.38	4.03		
15	8-52-0	0.35	4.32	3.97		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 6, 1925

Orifice used # 60
Temp. water 74°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading feet of water water column Left	Right	Diff.	Water column inches	Weight water and can lbs. Fairbanks 28x36268
16	8-54-0	0.35	4.27	3.92	7.7	18.00
17	8-56-0	0.35	4.30	3.95		
18	8-58-0	0.35	4.35	4.00		19.35
19	9-20-0	0.35	4.48	4.13	6.3	19.35
20	9-22-0	0.35	4.45	4.10		
21	9-24-0	0.35	4.43	4.08		
22	9-26-0	0.35	4.41	4.06		
23	9-28-0	0.35	4.38	4.03		
24	9-30-0	0.35	4.35	4.00		
25	9-32-0	0.35	4.38	4.03		
26	9-34-0	0.35	4.40	4.05		
27	9-36-0	0.35	4.40	4.05		
28	9-38-0	0.35	4.38	4.03		
29	9-40-0	0.35	4.37	4.02		
30	9-42-0	0.35	4.35	4.00		
31	9-44-0	0.35	4.38	4.03		
32	9-46-0	0.35	4.41	4.06		
33	9-48-0	0.35	4.42	4.07		
34	9-50-0	0.35	4.41	4.06		
35	9-52-0	0.35	4.40	4.05		
36	9-54-0	0.35	4.38	4.03		
37	9-56-0	0.35	4.36	4.01		
38	9-58-0	0.35	4.35	4.00		
39	10- 0-0	0.35	4.37	4.02		
40	10-02-0	0.35	4.38	4.03		
41	10-04-0	0.35	4.38	4.03		
42	10-06-0	0.35	4.37	4.02		
43	10-08-0	0.35	4.36	4.01		
44	10-10-0	0.35	4.37	4.02		
45	10-12-0	0.35	4.39	4.04		
46	10-14-0	0.35	4.39	4.04		
47	10-16-0	0.35	4.39	4.04		
48	10-17-0	0.35	4.39	4.04	6.30	43.25 Howe 28x1866
49	10-30-0	0.35	4.48	4.13	6.7	2.70
50	10-32-0	0.35	4.48	4.13		
51	10-34-0	0.35	4.48	4.13		
52	10-36-0	0.35	4.48	4.13		
53	10-38-0	0.35	4.48	4.13		
54	10-40-0	0.35	4.48	4.13		
55	10-42-0	0.35	4.48	4.13		
56	10-43-34.5	0.35	4.48	4.13	6.7	8.47
57	10-50-0	0.35	4.48	4.13	6.7	2.70
58	10-52-0	0.35	4.48	4.13		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 6, 1925

Orifice used # 60
Temp. water 74°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading feet of water water column Left	Right	Diff.	Water column inches	Weight water and can lbs. Howe 28x 1866
59	10-54-0	0.35	4.48	4.13		
60	10-56-0	0.35	4.48	4.13		
61	10-58-0	0.35	4.48	4.13		
62	11- 0-0	0.35	4.48	4.13		
63	11-02-0	0.35	4.48	4.13		
64	11-03-33.5	0.35	4.48	4.13	6.7	8.47
65	11-16-0	0.32	8.45	8.13	6.8	2.70
66	11-17-0	0.32	8.44	8.12		
67	11-18-0	0.32	8.43	8.11		
68	11-19-0	0.32	8.44	8.12		
69	11-20-0	0.32	8.44	8.12		
70	11-21-0	0.32	8.44	8.12		
71	11-22-0	0.32	8.44	8.12		
72	11-23-0	0.32	8.44	8.12		
73	11-24-0	0.32	8.44	8.12		
74	11-25-0	0.32	8.44	8.12		
75	11-26-0	0.32	8.44	8.12		
76	11-26-19	0.32	8.44	8.12	6.8	8.47
77	11-33-0	0.32	8.43	8.11	6.8	2.70
78	11-34-0	0.32	8.43	8.11		
79	11-35-0	0.32	8.44	8.11		
80	11-36-0	0.32	8.44	8.11		
81	11-37-0	0.32	8.44	8.11		
82	11-38-0	0.32	8.44	8.11		
83	11-39-0	0.32	8.44	8.11		
84	11-40-0	0.32	8,44	8.11		
85	11-41-0	0.32	8.44	8.11		
86	11-42-0	0.32	8.44	8.11		
87	11-43-0	0.32	8.44	8.11		
88	11-43-19.5	0.32	8.44	8.11	6.8	8.47
		inches mercury				
		Meriam Company				
		Cleveland, Ohio				
		Total				
89	12-35-0	9.13	8.93	18.06	7.2	2.70
90	12-36-0	9.13	8.93	18.06		
91	12-37-0	9.12	8.92	18.04		
92	12-38-0	9.11	8.91	18.02		
93	12-39-0	9.10	8.90	18.00		
94	12-30-0	9.12	8.92	18.04		
95	12-31-0	9.14	8.94	18.08		
96	12-31-51	9.12	8.92	18.04	7.2	8.47
97	12-38-0	9.12	8.92	18.04	7.2	2.70
98	12-39-0	9.12	8.92	18.04		
99	12-40-0	9.12	8.92	18.04		
100	12-41-0	9.12	8.92	18.04		
101	12-42-0	9.12	8.92	18.04		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 6, 1925

Orifice used # 60
Temp. water 74°F

Run #	Time hr-min-sec Stop watch #5	Manometer Reading inches mercury Meriam company Cleveland, Ohio: Left	Right	Total	Water column inches	Weight water and can lbs. Howe 28x1866
102	12-43-0	9.12	8.92	18.04		
103	12-44-0	9.11	8.91	18.02		
104	12-44-49.8	9.11	8.91	18.02	7.2	8.47
		Head #/□' Crosby: 686317				Fairbanks 28x36268
105	2-54-0	23.9			7.80	5.20
106	2-56-0	23.8				
107	2-58-0	24.0				
108	3-0-0	24.0				
109	3-02-0	23.9				
110	3-04-0	23.8				
111	3-06-0	23.8				
112	3-08-0	23.9				
113	3-10-0	23.9				
114	3-12-0	23.8				
115	3-14-0	24.0			7.80	
116	3-16-0	24.0				
117	3-18-0	23.9				
118	3-20-0	23.8				
119	3-22-0	23.9			7.80	44.90
120	12-56-0	9.16	8.96	18.12	7.2	5.20
121	12-58-0	9.17	8.97	18.14		
122	1-0-0	9.15	8.95	18.10		
123	1-02-0	9.15	8.95	18.10		
124	1-04-0	9.13	8.93	18.06		
125	1-06-0	9.11	8.91	18.02		
126	1-08-0	9.12	8.92	18.04		
127	1-10-0	9.11	8.91	18.02		
128	1-12-0	9.10	8.90	18.00		
129	1-14-0	9.14	8.94	18.08		
130	1-16-0	9.15	8.95	18.10		
131	1-18-0	9.12	8.92	18.04		
132	1-20-0	9.11	8.91	18.02		
133	1-22-0	9.10	8.90	18.00		
134	1-24-0	9.10	8.90	18.00		
135	1-26-0	9.11	8.91	18.02	7.2	30.4
136	1-28-0	9.10	8.90	18.00		
137	1-30-0	9.10	8.90	18.00		
138	1-32-0	9.11	8.91	18.02		
139	1-34-0	9.11	8.91	18.02		
140	1-36-0	9.10	8.90	18.00		
141	1-38-0	9.18	8.98	18.16		
142	1-40-0	9.17	8.97	18.14		
143	1-42-0	9.15	8.95	18.10		
144	1-44-0	9.13	8.93	18.06		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 6, 1925

Orifice used # 60
Temp. water 74°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Manometer Reading Right	Manometer Reading Total inches of mercury Meriam Company Cleveland, Ohio	Water column inches	Weight water and can lbs. Fairbanks 28x36268
145	1-46-0	9.11	8.91	18.02	7.2	47.3
146	2-0-0	13.48	13.00	26.48	7.45	5.20
147	2-02-0	13.48	13.00	26.48		
148	2-04-0	13.58	13.10	26.68		
149	2-06-0	13.54	13.06	26.60		
150	2-08-0	13.53	13.05	26.58		
151	2-10-0	13.49	13.01	26.50		
152	2-12-0	13.48	13.00	26.48		
153	2-14-0	13.48	13.00	26.48		
154	2-16-0	13.48	13.00	26.48		
155	2-18-0	13.48	13.00	26.48		
156	2-20-0	13.56	13.08	26.64		
157	2-22-0	13.54	13.06	26.60		
158	2-24-0	13.51	13.03	26.54		
159	2-26-0	13.48	13.00	26.48		
160	2-28-0	13.58	13.10	26.68		
161	2-30-0	13.58	13.10	26.68		
162	2-32-0	13.54	13.06	26.60		
163	2-34-0	13.50	13.02	26.52		
164	2-36-0	13.66	13.18	26.84		
165	2-38-0	13.68	13.20	26.88		
166	2-40-0	13.66	13.18	26.84	7.45	45.62

August 10, 1925

Orifice used # 55
Temp. Water 78°F

1	8-06-0	8.55	8.35	16.90	6.70	5.20
2	8-07-0	8.45	8.25	16.70		
3	8-08-0	8.38	8.18	16.56		
4	8-09-0	8.45	8.25	16.70		
5	8-10-0	8.58	8.38	16.69		
6	8-11-0	8.62	8.42	17.04		
7	8-12-0	8.58	8.38	16.96		
8	8-13-0	8.58	8.38	16.96		
9	8-14-0	8.56	8.36	16.92		
10	8-15-0	8.54	8.34	16.88		
11	8-16-0	8.55	8.35	16.90		
12	8-17-0	8.52	8.32	16.84		
13	8-18-0	8.55	8.35	16.90		
14	8-19-0	8.62	8.42	17.04		
15	8-20-0	8.65	8.45	17.10		
16	8-21-0	8.60	8.40	17.00	6.7	24.00
17	8-22-0	8.55	8.35	16.90		
18	8-23-0	8.63	8.43	17.06		
19	8-24-0	8.75	8.55	17.30		
20	8-25-0	8.80	8.60	17.40		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 55
Temp. water 78°F

Howell, R. S.
August 10, 1925

Run #	Time hr-min-sec Stop watch #5	Manometer Reading Left	Right	Total inches of mercury Meriam Company Cleveland, Ohio	Water column inches	Weight water and can lbs. Fairbanks 28x36268
21	8-36-0	8.79	8.59	17.38		
22	8-27-0	8.76	8.56	17.32		
23	8-28-0	8.70	8.50	17.20		
24	8-29-0	8.64	8.44	17.08		
25	8-30-0	8.58	8.38	16.96		
26	8-31-0	8.51	8.31	16.82		
27	8-32-0	8.50	8.30	16.80		
28	8-33-0	8.52	8.32	16.84		
29	8-34-0	8.56	8.36	16.92		
30	8-35-0	8.59	8.39	16.98		
31	8-36-0	8.60	8.40	17.00	6.70	42.75
32	8-46-0	5.20	5.12	10.32	6.40	5.25
33	8-47-0	5.20	5.12	10.32		
34	8-48-0	5.18	5.10	10.28		
35	8-49-0	5.18	5.10	10.28		
36	8-50-0	5.16	5.08	10.24		
37	8-51-0	5.16	5.08	10.24		
38	8-52-0	5.17	5.09	10.26		
39	8-53-0	5.17	5.09	10.26		
40	8-54-0	5.16	5.08	10.24		
41	8-55-0	5.14	5.06	10.20		
42	8-56-0	5.13	5.05	10.18		
43	8-57-0	5.11	5.03	10.14		
44	8-58-0	5.10	5.02	10.12		
45	8-59-0	5/20	5.12	10.32		
46	9- 0-0	5.27	5.19	10.46		
47	9-01-0	5.29	5.21	10.50		
48	9-02-0	5/32	5.24	10.56		
49	9-03-0	5.33	5.25	10.58		
50	9-04-0	5.31	5.23	10.54	6.40	23.00
51	9-05-0	5.29	5.21	10.50		
52	9-06-0	5.28	5.20	10.48		
53	9-07-0	5.28	5.20	10.48		
54	9-08-0	5.28	5.20	10.48		
55	9-09-0	5.28	5.20	10.48		
56	9-10-0	5.28	5.20	10.48		
57	9-11-0	5.28	5.20	10.48		
58	9-12-0	5.26	5.18	10.44		
59	9-13-0	5.24	5.16	10.40		
60	9-14-0	5.22	5.14	10.36		
61	9-15-0	5.20	5.12	10.32		
62	9-16-0	5.17	5.09	10.26		
63	9-17-0	5.13	5.05	10.18		
64	9-18-0	5.10	5.02	10.12		
65	9-19-0	5.11	5.03	10.14		
66	9-20-0	5.13	5.05	10.18		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 55
Temp. water 78°F

Howell, R. S.
August 10, 1925

Run #	Time hr-min-sec Stop watch #5	Manometer Reading Left	Manometer Reading Right	Manometer Reading Total	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		inches of mercury Meriam Comapny Cleveland, Ohio				
67	9-31-0	5.14	5.06	10.20		
68	9-22-0	5.14	5.06	10.20	6.40	40.85
		feet of water water column				
				Diff		
69	9-40-0	0.32	8.41	8.09	6.90	5.25
70	9-41-0	0.32	8.38	8.06		
71	9-42-0	0.32	8.38	8.06		
72	9-43-0	0.32	8.39	8.07		
73	8-44-0	0.32	8.38	8.06		
74	8-45-0	0.32	8.38	8.06		
75	8-46-0	0.32	8.38	8.06		
76	8-47-0	0.32	8.37	8.05		
77	8-48-0	0.32	8.38	8.06		
78	8-49-0	0.32	8.38	8.06		
79	8-50-0	0.32	8.39	8.07		
80	8-51-0	0.32	8.39	8.07		
81	9-52-0	0.32	8.38	8.06		
82	9-53-0	0.32	8.38	8.06		
83	9-54-0	0.32	8.35	8.03		
84	9-55-0	0.32	8.35	8.03		
85	9-56-0	0.32	8.45	8.13		
86	9-57-0	0.32	8.51	8.19		
87	9-58-0	0.32	8.53	8.21		
88	9-59-0	0.32	8.54	8.22		
89	10- 0-0	0.32	8.52	8.20		
90	10-01-0	0.32	8.50	8.18		
91	10-02-0	0.32	8.47	8.15		
92	10-03-0	0.32	8.43	8.11		
93	10-04-0	0.32	8.41	8.09		
94	10-05-0	0.32	8.41	8.09		
95	10-06-0	0.32	8.43	8.11		
96	10-07-0	0.32	8.47	8.15		
97	10-08-0	0.32	8.49	8.17		
98	10-09-0	0.32	8.50	8.18		
99	10-10-0	0.32	8.50	8.18	6.90	30.35
100	10-11-0	0.32	8.49	8.17		
101	10-12-0	0.32	8.48	8.16		
102	10-13-0	0.32	8.46	8.14		
103	10-14-0	0.32	8.43	8.11		
104	10-15-0	0.32	8.40	8.08		
105	10-16-0	0.32	8.35	8.03		
106	10-17-0	0.32	8.33	8.01		
107	10-18-0	0.32	8.34	8.02		
108	10-19-0	0.32	8.36	8.04		
109	10-20-0	0.32	8.37	8.05		
110	10-21-0	0.32	8.38	8.06		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 10, 1925

Orifice used # 55
Temp. water 78°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Manometer Reading Right	Manometer Reading Diff.	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		feet of water column				
111	10-32-0	0.32	8.38	8.06		
112	10-33-0	0.32	8.38	8.06		
113	10-34-0	0.32	8.36	8.04		
114	10-35-0	0.32	8.34	8.02		
115	10-36-0	0.32	8.32	8.00		
116	10-37-0	0.32	8.33	8.01		
117	10-38-0	0.32	8.36	8.04		
118	10-39-0	0.32	8.38	8.06		
119	10-30-0	0.32	8.41	8.09	6.90	47.10
120	11-30-0	0.35	4.32	3.97	7.5	2.70
121	11-31-0	0.35	4.31	3.96		
122	11-32-0	0.35	4.32	3.97		
123	11-33-0	0.35	4.31	3.96		
124	11-34-0	0.35	4.32	3.97		
125	11-35-0	0.35	4.29	3.94		
126	11-36-0	0.35	4.29	3.94		
127	11-37-0	0.35	4.29	3.94		
128	11-38-0	0.35	4.29	3.94		
129	11-39-0	0.35	4.28	3.93		
130	11-39-16.6	0.35	4.27	3.92		8.47
Temp. water 81°F						Howe 28x1866
131	1-26-0	0.35	4.40		6.65	2.70
132	1-27-0	0.35	4.42			
133	1-28-0	0.35	4.42			
134	1-29-0	0.35	4.43			
135	1-30-0	0.35	4.42			
136	1-31-0	0.35	4.44			
137	1-32-0	0.35	4.47			
138	1-33-0	0.35	4.45			
139	1-34-0	0.35	4.42			
140	1-35-0	0.35	4.40		6.65	8.47
			$ Av.			
		0.35	4.437	4.08		5.77
141	2- 0-0	0.35	4.36		7.1	2.7
142	2-01-0	0.35	4.37			
143	2-02-0	0.35	4.35			
144	2-03-0	0.35	4.32			
145	2-04-0	0.35	4.33			
146	2-05-0	0.35	4.36			
147	2-06-0	0.35	4.37			
148	2-07-0	0.35	4.35			
149	2-08-0	0.35	4.31			
150	2-09-04.6	0.35	4.32		7.1	8.47
			AV.			
		0.35	4.344	3.994	7.1	8.47

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 55
Temp. water 81°F

Howell, R. S.
August 10, 1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Diff. feet of water water column	Water column inches	Weight water and can lbs. Howe 28x1866
151	2-45-0	0.36	2.02	1.66	7.0	2.7
152	5 2-46-0	0.36	2.01	1.65		
153	2-47-0	0.36	2.02	1.66		
154	2-48-0	0.36	2.08	1.72		
155	2-49-0	0.36	2.09	1.73		
156	2-50-0	0.36	2.08	1.72		
157	2-51-0	0.36	2.04	1.68		
158	2-52-0	0.36	2.02	1.66		
159	2-53-0	0.36	2.02	1.66		
160	2-54-0	0.36	2.03	1.67		
161	2-55-0	0.36	2.04	1.68		
162	2-56-0	0.36	2,04	1.68		
163	2-57-0	0.36	2.02	1.66		
164	2-57-35.8	0.36	1.99	1.63	7.0	8.47
165	3-17-0	0.36	2.03	1.67	6.10	2.7
166	3-18-0	0.36	2.02	1.66		
167	3-19-0	0.36	2.06	1.70		
168	3-20-0	0.36	2.05	1.69		
169	3-21-0	0.36	2.03	1.67		
170	3-22-0	0.36	2.02	1.66		
171	3-23-0	0.36	2.01	1.65		
172	4 3-24-0	0.36	2.01	1.65		
173	3-25-0	0.36	2.02	1.66		
174	3-26-0	0.36	2.01	1.65		
175	3-27-0	0.36	2.01	1.65		
176	3-28-0	0.36	2.02	1.66		
177	3-29-0	0.36	2.05	1.69		
178	3-29-58.2	0.36	2.08	1.72	6.10	8.47

August 11, 1925

Orifice used # 53
Temp. water 74°F

1	7-58-0	0.36	2.02	1.66	6.30	2.70
2	7-59-0	"	2.02			
3	8- 0-0	"	2.02			
4	8-01-0	"	2.03	1.67		
5	8-02-0	"	2.04	1.68		
6	8-03-0	"	2.03	1.67		
7	8-04-0	"	2.02			
8	8-05-0	"	2,02			
9	8-06-0	"	2.02			
10	8-07-0	"	2.02			
11	8-07-32.8	0.36	2.02	1.66	6.30	8.47
12	8-14-0	0.36	2.02		6.40	2.70

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 53
Temp. water 74°F

Howell, R. S.
August 11,1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Manometer Reading Right	Diff. feet of water water column	Water column inches	Weight water and can lbs. Howe 28x1866
13	8-15-0	0.36	2.04			
14	8-16-0	"	2.06			
15	8-17-0	"	2.07			
16	8-18-0	"	2.07			
17	8-19-0	"	2.04			
18	8-20-0	"	2.04			
19	8-21-0	"	2.05			
20	8-22-0	0.36	2.04			
21	8-23-31.6	"	2.03			
		Av. 0.36	Av. 2.045	1.68	6.50	8.47
22	8-31-0	0.35	4.21		6.75	2.70
23	8-32-0	"	4.22			
24	8-33-0	0.35	4.22			
25	8-34-0	"	4.22			
26	8-35-0	"	4.22			
27	8-36-0	"	4.22			
28	8-37-0	"	4.23			
29	8-38-48	0.35	4.22			
		Av. 0.35	Av. 4.22	3.87	6.75	8.47
30	8-43-0	0.35	4.22		6.75	2.70
31	8-44-0	"	4.22			
32	8-45-0	"	4.22			
33	8-46-0	"	4.22			
34	8-47-0	"	4.22			
35	8-48-0	"	4.22			
36	8-49-0	"	4.22			
37	8-49-49	0.35	4.22			
		Av. 0.35	Av. 4.22	3.87	6.75	8.47
38	9- 0-0	0.32	8.46		7.4	2.70
39	9-01-0	"	8.46			
40	9-02-0	"	8.47			
41	9-03-0	"	8.46			
42	9-04-0	"	8.47			
43	9-04-57.6	0.32	8.47		7.4	8.47
			8.465	8.14		
44	9-09-0	0.32	8.45		7.40	2.7
45	9-10-0	"	8.48			
46	9-11-0	"	8.52			

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 11, 1925

Orifice used # 53
Temp. of water 74 °F

Run #	Time hr-min-sec Stop watch #5	Manometer Reading feet of water water column Left	Right	Diff.	Water column inches	Weight water and can lbs. Howe 28x1866
47	9-12-0	0.32	8.45			
48	9-13-0	"	8.46			
49	9-13-57.4	0.32	8.45			
		Av.	Av.			
		0.32	8.476	8.15	7.40	8.47
		inches of mercury				Fairbanks
		The Meriam Company				28x36268
		Cleveland, Ohio				
				Total		
50	9-35-0	5.38	5.30	10.68	7.0	5.18
51	9-36-0	5.20	5.22	10.52		
52	9-37-0	5.23	5.15	10.38		
52	9-38-0	5.23	5.15	10.38		
53	9-39-0	5.23	5.15	10.38		
54	9-40-0	5.24	5.16	10.40		
55	9-41-0	5.23	5.15	10.38		
56	9-42-0	5.43	5.35	10.78		
57	9-43-0	5.50	5.42	10.92		
58	9-44-0	5.49	5.41	10.90		
59	9-45-0	5.46	5.38	10.84		
60	9-46-0	5.44	5.36	10.80		
61	9-47-0	5.40	5.32	10.72		
62	9-48-0	5.39	5.31	10.70		
63	9-49-0	5.38	5.30	10.68		
64	9-50-0	5.30	5.22	10.52		
65	9-51-0	5.36	5.28	10.64		
66	9-52-0	5.38	5.30	10.68		
67	9-53-0	5.38	5.30	10.68		
68	9-54-0	5.28	5.30	10.68		
69	9-55-0	5.36	5.28	10.64		33.0
70	9-56-0	5.43	5.35	10.78		
71	9-57-0	5.53	5.45	10.98		
72	9-58-0	5.40	5.32	10.72		
73	9-59-0	5.37	5.29	10.66		
74	10- 0-0	5.36	5.28	10.64		
75	10-01-0	5.36	5.28	10.64		
76	10-02-0	5.37	5.29	10.66		
77	10-03-0	5.34	5.26	10.60		
78	10-04-0	5.33	5.25	10.58		
79	10-05-0	5.29	5.21	10.50	7.0	46.70
80	10-25-0	9.10	8.90	18.00	7.3	21.15
81	10-26-0	9.12	8.92	18.04		
82	10-27-0	9.16	8.96	18.12		
83	10-28-0	9.17	8.97	18.14		
84	10-29-0	9.12	8.92	18.04		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 11,1925

Orifice used # 53
Temp. of water 74°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total (inches of mercury The meriam Company: Cleveland, Ohio)	Water column inches	Weight water and can lbs. Fairbanks 28x36268
85	10-30-0	9.08	8.88	17.96		
86	10-31-0	9.09	8.89	17.98		
87	10-32-0	9.12	8.92	18.04		
88	10-33-0	9.11	8.91	18.02		
89	10-34-0	9.13	8.93	18.06		
90	10-35-0	9.11	8.91	18.04		
91	10-36-0	9.11	8.91	18.04		
92	10-37-0	9.14	8.94	18108		
93	10-38-0	9.08	8.88	17.96		
94	10-39-0	9.16	8.96	18.12		
95	10-40-0	9.17	8.97	18.14	7.35	47.70
96	10-41-0	9.20	9.00	18.20		
97	10-42-0	9.20	9.00	18.20		
98	10-43-0	9.17	8.97	18.14		
99	10-44-0	9.17	8.97	18.14		
100	10-45-0	9.18	8.98	18.16		
101	10-46-0	9.18	8.98	18.16		
102	10-47-0	9.11	8.91	18.02		
103	10-48-0	9.08	8.88	17.96		
104	10-49-0	9.10	8.90	18.00		
105	10-50-0	9.10	8.90	18.00		
106	10-51-0	9.15	8.95	18.10		
107	10-52-0	9.15	8.95	18.10		
108	10-53-0	9.10	8.90	18.00		
109	10-54-0	9.10	8.90	18,00		
110	10-55-0	9.10	8.90	18.00	7.35	74.35
111	11-30-0	13.70	13.22	26.92	7.50	21.15
112	11-31-0	13.68	13.20	26.88		
113	11-32-0	13.70	13.22	26.92		
114	11-33-0	13.72	13.24	26.96		
115	11-34-0	13.74	13.26	27.00		
116	11-35-0	13.72	13.24	26.96		
117	11-36-0	13.76	13.28	27.04		
118	11-37-0	13.70	13.22	26.92		
119	11-38-0	13.66	13.18	26.84		
120	11-39-0	13.68	13.20	26.88		
121	11-40-0	13.72	13.24	26.96		
122	11-41-0	13.83	13.35	27.18		
123	11-42-0	13.78	13.30	27.08		
124	11-43-0	13.80	13.32	27.12		
125	11-44-0	13.84	13.36	27.20		
126	11-45-0	13.83	13.35	27.18	7.70	53.40
127	11-46-0	13.76	13.28	27.04		
128	11-47-0	13.74	13.26	27.00		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 11,1925

Orifice used # 53
Temp. water 74°F

Run #	Time hr-min-sec Stop Watch # 5	Manometer Reading Left	Right	Total inches of mercury The Meriam Company Cleveland, Ohio	Water column inches	Weight water and can lbs. Fairbanks 28x36268
129	11-48-0	13.83	13.35	27.18		
130	11-49-0	13.78	13.30	27.08		
131	11-50-0	13.82	13.34	27.16		
132	11-51-0	13.86	13.38	27.24		
133	11-52-0	13.86	13.38	27.24		
134	11-53-0	13.86	13.38	27.24		
135	11-54-0	13.86	13.38	27.24		
136	11-55-0	13.82	13.34	27.16		
137	11-56-0	13.84	13.36	27.20		
138	11-57-0	13.76	13.28	27.04		
139	11-58-0	13.70	13.22	26.92		
140	11-59-0	13.70	13.22	26.92		
141	12- 0-0	13.70	13.22	26.92	7.80	85.70
		Head #/□" Crosby 686317				
142	12-33-0	23.8			7.45	21.15
143	12-34-0	23.9				
144	12-35-0	23.8				
145	12-36-0	23.9				
146	12-37-0	23.8				
147	12-38-0	23.9				
148	12-39-0	23.8				
149	12-40-0	23.6				
150	12-41-0	23.8				
151	12-42-0	23.8				
152	12-43-0	23.6				
153	12-44-0	23.6				
154	12-45-0	23.5				
155	12-46-0	23.6				
156	12-47-0	23.6				
157	12-48-0	23.4			7.50	63.00
158	12-49-0	23.3				
159	12-50-0	23.6				
160	12-51-0	23.9				
161	12-52-0	23.8				
162	12-53-0	23.8				
163	12-54-0	23.6				
164	12-55-0	23.6				
165	12-56-0	23.6				
166	12-57-0	23.6				
167	12-58-0	23.6				
168	12-59-0	23.8				
169	1 - 0-0	23.6				

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 11, 1925

Orifice used # 53
Temp. water 74°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches of mercury The Meriam Company Cleveland, Ohio			Water column inches	Weight water and can lbs. Fairbanks 28x36268
		Left	Right	Total		
		Head: #/□" Crosby: 686317				
170	1-01-0	23.2				
171	1-02-0	23.5				
172	1-03-0	23.4			7.50	104.75
173	1-04-0	34.9			7.75	21.20
174	1-15-0	34.6				
175	1-16-0	34.5				
176	1-17-0	34.7				
177	1-18-0	34.4				
178	1-19-0	34.4				
179	1-20-0	34.5				
180	1-21-0	34.4				
181	1-22-0	34.4				
182	1-23-0	34.5				
183	1-24-0	34.3				
184	1-25-0	34.3				
185	1-26-0	34/2				
186	1-27-0	34.6				
187	1-28-0	34.7				
188	1-29-0	34.6			7.80	71.80
189	1-30-0	34.5				
190	1-31-0	34.5				
191	1-32-0	34.5				
192	1-33-0	34.5				
193	1-34-0	34.5				
194	1-35-0	34.4				
195	1-36-0	34.4				
196	1-37-0	34.5				
197	1-38-0	34.5				
198	1-39-0	34.5				
199	1-40-0	34.6				
200	1-41-0	34.7				
201	1-42-0	34.8				
202	1-43-0	34.7				
203	1-44-0	34.8			7.85	122.60

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 29, 1925.

Orifice used # 80
Temp. water 68°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
	0	5.00				0	5.00		
1 +	8-04-0	83.2	7.55	5.25	44	9-30-0	84.1		
2	8-06-0	84.3			45	9-32-0	83.9		
3	8-08-0	84.0			46	9-34-0	84.1		
4	8-10-0	84.8			47	9-36-0	84.5		
5	8-12-0	84.6			48	9-38-0	84.7		
6	8-14-0	84.4			49	9-40-0	84.9		
7	8-16-0	84.9			50	9-42-0	85.0		
8	8-18-0	85.0			51	9-44-0	85.0	8.0	48.90
9	8-20-0	85.0			Orifice used #:80				
10	8-22-0	85.2			Temp water 70°F				
11	8-24-0	85.5	7.65	14.00	52	10-08-0	74.0	7.50	5.25
12	8-26-0	85.4			53	10-10-0	73.9		
13	8-28-0	85.2			54	10-12-0	73.9		
14	8-30-0	85.0			55	10-14-0	73.8		
15	8-32-0	84.9			56	10-16-0	74.2		
16	8-34-0	85.0			57	10-18-0	74.2		
17	8-36-0	85.0			58	10-20-0	74.1		
18	8-38-0	84.0			59	10-22-0	74.1		
19	8-40-0	84.0			60	10-24-0	74.0		
20	8-42-0	84.1			61	10-26-0	74.0		
21	8-44-0	84.3	7.75	22.75	62	10-28-0	74.0	7.55	13.50
22	8-46-0	84.2			63	10-30-0	74.0		
23	8-48-0	84.4			64	10-32-0	74.3		
24	8-50-0	84.4			65	10-34-0	74.0		
25	8-52-0	84.6			66	10-36-0	74.7		
26	8-54-0	84.8			67	10-38-0	74.2		
27	8-56-0	84.6			68	10-40-0	74.0		
28	8-58-0	84.3			69	10-42-0	74.0		
29	9- 0-0	84.0			70	10-44-0	74.1		
30	9-02-0	84.0			71	10-46-0	74.0		
31	9-04-0	84.1	7.80	31.50	72	10-48-0	73.9	7.60	21.70
32	9-06-0	84.3			73	10-50-0	73.8		
33	9-08-0	84.5			74	10-52-0	73.9		
34	9-10-0	84.3			75	10-54-0	74.4		
35	9-12-0	84.1			76	10-56-0	74.5		
36	9-14-0	83.6			77	10-58-0	74.6		
37	9-16-0	83.5			78	11- 0-0	74.7		
38	9-18-0	83.6			79	11-02-0	74.7		
39	9-20-0	84.0			80	11-04-0	74.8		
40	9-22-0	84.2			81	11-06-0	74.9		
41	9-24-0	84.1	7.9	40.25	82	11-08-0	74.9	7.70	29.90
42	9-26-0	84.1			83	11-10-0	74.0		
43	9-28-0	84.2			84	11-12-0	73.7		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 80
Temp. water 70°F

Howell, R. S.
July 29, 1925.

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36368
	0	5.00				0	5.00		
85	11-14-0	73.5			129	12-52-0	64.4		
86	11-16-0	74.0			130	12-54-0	64.2		
87	11-18-0	74.0			131	12-56-0	64.0		
88	11-20-0	74.1			132	12-58-0	64.0		
89	11-22-0	73.5			133	1-00-0	64.2		
90	11-24-0	72.8			134	1-02-0	64.4		
91	11-26-0	73.5			135	1-04-0	64.5		
92	11-28-0	73.5	7.72	38.15	136	1-06-0	65.5		
93	11-30-0	74.0			137	1-08-0	64.2		
94	11-32-0	75.0			138	1-10-0	64.1	7.90	28.30
95	11-34-0	74.5			139	1-12-0	63.9		
96	11-36-0	74.0			140	1-14-0	64.0		
97	11-38-0	74.2			141	1-16-0	63.8		
98	11-40-0	73.8			142	1-18-0	63.9		
99	11-42-0	74.0			143	1-20-0	63.5		
100	11-44-0	74.0			144	1-22-0	63.0		
101	11-46-0	74.5			145	1-24-0	63.0		
102	11-48-0	74.2	7.80	46.35	146	1-26-0	63.0		
103	11-50-0	74.0			147	1-28-0	64.8		
104	11-52-0	74.0			148	1-30-0	64.9	8.00	35.95
105	11-54-0	74.6			149	1-32-0	65.0		
106	11-56-0	74.6			150	1-34-0	65.2		
107	11-57-0	74.4	7.80	49.92	151	1-36-0	65.1		
	Temp water 71°F				152	1-38-0	64.6		
108	12-10-0	64.0	7.70	5.30	153	1-40-0	64.5		
109	12-12-0	63.8			154	1-42-0	64.0		
110	12-14-0	64.1			155	1-44-0	64.1		
111	12-16-0	64.0			156	1-46-0	64.2		
112	12-18-0	64.0			157	1-48-0	64.0		
113	12-20-0	64.0			158	1-50-0	63.9	8.00	43.60
114	12-22-0	64.0			159	1-52-0	63.9		
115	12-24-0	64.0			160	1-54-0	64.2		
116	12-26-0	64.0			161	1-56-0	64.0		
117	12-28-0	64.2			162	1-58-0	64.0		
118	12-30-0	64.1	7.80	13.0	163	2-00-0	63.8	8.00	47.38
119	12-32-0	64.5				Temp. water 72°F			
120	12-34-0	64.6			164	2-06-0	55.5	7.4	5.30
121	12-36-0	64.8			165	2-18-0	55.1		
122	12-38-0	64.8			166	2-20-0	54.9		
123	12-40-0	64.6			167	2-22-0	54.9		
124	12-42-0	64.0			168	2-24-0	55.5		
125	12-44-0	64.2			169	2-26-0	56.6		
126	12-46-0	64.9			170	2-28-0	56.4		
127	12-48-0	64.9			171	2-30-0	56.1		
128	12-50-0	64.4	7.85	20.65	172	2-32-0	55.6		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 80 — Howell, R. S.
Temp. water 72°F
July 29, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
	0		5.00	
173	2-34-0	55.0		
174	2-36-0	55.0	7.45	12.45
175	2-38-0	55.2		
176	2-40-0	55.2		
177	2-42-0	55.0		
178	2-44-0	55.5		
179	2-46-0	55.5		
180	2-48-0	55.6		
181	2-50-0	55.9		
182	2-52-0	55.5		
183	2-54-0	55.3		
184	2-56-0	55.1	7.50	20.65
185	2-58-0	54.9		
186	3-0-0	54.8		
187	3-02-0	56.5		
188	3-04-0	56.8		
189	3-06-0	55.6		
190	3-08-0	55.2		
191	3-10-0	54.9		
192	3-12-0	55.0		
193	3-14-0	55.8		
194	3-16-0	55.4	7.60	26.75
195	3-18-0	55.6		
196	3-20-0	55.5		
197	3-22-0	55.4		
198	3-24-0	55.4		
199	3-26-0	55.1		
200	3-28-0	55.5		
201	3-30-0	55.5		
202	3-32-0	55.7		
203	3-34-0	55.8		
204	3-36-0	55.6	7.65	33.95
205	3-38-0	55.5		
206	3-40-0	55.3		
207	3-42-0	55.2		
208	3-44-0	55.1		
209	3-46-0	55.2		
210	3-48-0	55.1		
211	3-50-0	55.2		
212	3-52-0	55.2		
213	3-54-0	55.0		
214	3-56-0	55.0	7.68	46.1
215	3-58-0	55.4		
216	4-0-0	55.8		
217	4-02-0	55.9		
218	4-04-0	55.5		
219	4-06-0	55.5		
220	4-08-0	55.5		
221	4-10-0	55.4		
222	4-12-0	55.5		
223	4-14-0	55.8		
224	4-16-0	55.5	7.7	48.1

Orifice used # 80
Temp. water 70°F
July 30, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs Fairbanks 28x36268
	0		5.00	
1	8-20-0	44.0	7.15	5.35
2	8-22-0	44.0		
3	8-24-0	44.0		
4	8-26-0	44.0		
5	8-28-0	44.1		
6	8-30-0	44.2		
7	8-32-0	44.1		
8	8-34-0	44.0		
9	8-36-0	44.0		
10	8-38-0	44.0		
11	8-40-0	44.2	7.20	11.65
12	8-42-0	44.1		
13	8-44-0	44.0		
14	8-46-0	44.2		
15	8-48-0	44.5		
16	8-50-0	44.5		
17	8-52-0	44.3		
18	8-54-0	44.2		
19	8-56-0	44.1		
20	8-58-0	44.1		
21	9-0-0	44.2	7.20	18.05
22	9-02-0	44.2		
23	9-04-0	44.2		
24	9-06-0	44.2		
25	9-08-0	44.1		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
July 30, 1925

Orifice used # 80
Temp. water 70°F

Run #	Time hr-min-sec: Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec: Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
26	9-10-0	44.1			69	10-54-0	35.1		
27	9-12-0	44.4			70	10-56-0	35.0		
28	9-14-0	44.7			71	10-58-0	34.9		
29	9-16-0	44.8			72	11-0-0	34.2	7.1	11.02
30	9-18-0	44.8			73	11-02-0	33.9		
31	9-20-0	44.8	7.25	24.50	74	11-04-0	33.9		
32	9-22-0	44.9			75	11-06-0	34.1		
33	9-24-0	44.9			76	11-08-0	34.6		
34	9-26-0	44.9			77	11-10-0	34.9		
35	9-28-0	44.7			78	11-12-0	35.0		
36	9-30-0	44.0			79	11-14-0	35.1		
37	9-32-0	42.5			80	11-16-0	35.2		
38	9-34-0	43.8			81	11-18-0	35.1		
39	9-36-0	45.0			82	11-20-0	35.2	7.15	16.70
40	9-38-0	45.0			83	11-22-0	35.1		
41	9-40-0	44.6	7.28	30.90	84	11-24-0	35.0		
42	9-42-0	44.2			85	11-26-0	34.8		
43	9-44-0	44.0			86	11-28-0	34.5		
44	9-46-0	43.8			87	11-30-0	33.9		
45	9-48-0	43.6			88	11-32-0	33.7		
46	9-50-0	43.8			89	11-34-0	33.6		
47	9-52-0	44.2			90	11-36-0	33.8		
48	9-54-0	44.7			91	11-38-0	33.7		
49	9-56-0	44.9			92	11-40-0	33.5	7.15	22.35
50	9-58-0	45.0			93	11-42-0	33.6		
51	10-0-0	45.0	7.30	37.3	94	11-44-0	33.8		
52	10-02-0	44.8			95	11-46-0	33.9		
53	10-04-0	44.5			96	11-48-0	33.9		
54	10-06-0	44.2			97	11-50-0	34.0		
55	10-08-0	43.9			98	11-52-0	33.6		
56	10-10-0	43.9			99	11-54-0	34.1		
57	10-12-0	44.0			100	11-56-0	34.6		
58	10-14-0	43.2			101	11-58-0	34.9		
59	10-16-0	43.1		5	102	12-0-0	35.0	7.20	27.90
60	10-18-0	43.9			103	12-02-0	34.8		
61	10-20-0	44.2	7.32	43.70	104	12-04-0	34.8		
	Temp. water 72°F				105	12-06-0	34.7		
62	10-22-0	34.5	7.1	5.32	106	12-08-0	34.4		
63	10-42-0	34.6			107	12-10-0	34.4		
64	10-44-0	34.9			108	12-12-0	34.8		
65	10-46-0	35.2			109	12-14-0	35.0		
66	10-48-0	35.5			110	12-16-0	34.6		
67	10-50-0	35.2			111	12-18-0	34.7		
68	10-52-0	35.4			112	12-20-0	34.4	7.20	33.60

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R S.

Orifice used #80
Temp. water 72°F
July 30, 1925.

Run #	Time hr-min-sec: Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 38x36268	Run #	Time hr-min-sec: Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 38x36268
	0		5.00			0		5.00	
113	12-22-0	34.4			154	2-04-0	24.1		
114	12-24-0	34.4			155	2-06-0	24.2		
115	12-26-0	34.4			156	2-08-0	24.3		
116	12-28-0	34.2			157	2-10-0	24.3		
117	12-30-0	34.2			158	2-12-0	24.2	7.95	19.52
118	12-32-0	34.3			159	2-14-0	24.0		
119	12-34-0	34.4			160	2-16-0	24.1		
120	12-36-0	34.2			161	2-18-0	24.3		
121	12-38-0	34.0			162	2-20-0	24.5		
122	12-40-0	33.6	7.25	28.25	163	2-22-0	24.5		
123	12-42-0	34.0			164	2-24-0	24.5		
124	12-44-0	34.3			165	2-26-0	24.4		
125	12-46-0	34.6			166	2-28-0	24.3		
126	12-48-0	34.7			167	2-30-0	24.3		
127	12-50-0	34.7	7.30	42.00	168	2-32-0	24.3	8.00	24.32
	Temp. water 73°F				169	2-34-0	24.0		
128	1-12-0	24.1	7.9	5.32	170	2-36-0	24.4		
129	1-14-0	23.6			171	2-38-0	24.5		
130	1-16-0	23.8			172	2-40-0	24.5		
131	1-18-0	23.4			173	2-42-0	24.4		
132	1-20-0	23.3			174	2-44-0	24.3		
133	1-22-0	23.2			175	2-46-0	24.1		
134	1-24-0	23.2			176	2-48-0	24.2		
135	1-26-0	23.2			177	2-50-0	24.5		
136	1-28-0	23.5			178	2-52-0	25.1	8.02	29.10
137	1-30-0	23.7			179	2-54-0	24.8		
138	1-32-0	23.6	7.90	10.00	180	2-56-0	24.5		
139	1-34-0	23.5			181	2-58-0	24.5		
140	1-36-0	23.4			182	3-0-0	24.7		
141	1-38-0	23.2			183	3-02-0	24.8		
142	1-40-0	23.2			184	3-04-0	24.8		
143	1-42-0	23.8			185	3-06-0	24.7		
144	1-44-0	23.8			186	3-08-0	24.2		
145	1-46-0	23.8			187	3-10-0	24.2		
146	1-48-0	23.8			188	3-12-0	24.2	8.05	33.95
147	1-50-0	23.8			189	3-14-0	24.4		
148	1-52-0	23.7	7.92	14.70	190	3-16-0	24.5		
149	1-54-0	23.8			191	3-18-0	24.4		
150	1-56-0	24.0			192	3-20-0	24.2		
151	1-58-0	24.4			193	3-22-0	24.1	8.08	36.40
152	2-0-0	24.4							
153	2-02-0	24.1							

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 46
Temp. water 76°F
August 13, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
1	12-58-0	21.1	6.8	21.25	45	2-07-0	44.2		
2	12-59-0	21.1			46	2-08-0	44.2		
3	1- 0-0	21.2			47	2-09-0	44.2		
4	1-01-0	21.1			48	2-10-0	44.2		
5	1-02-0	21.0			49	2-11-0	44.1		
6	1-03-0	21.0			50	2-12-0	44.1		
7	1-04-0	21.1			51	2-13-0	44.2	7.60	126.55
8	1-05-0	21.1			52	2-26-0	57.5	7.80	21.25
9	1-06-0	21.1	6.80	57.40	53	2-27-0	57.6		
10	1-07-0	21.0			54	2-28-0	57.8		
11	1-08-0	21.1	5		55	2-29-0	57.8		
12	1-09-0	21.1			56	2-30-0	57.8		
13	1-10-0	21.1			57	2-31-0	57.8		
14	1-11-0	21.1			58	2-32-0	57.6		
15	1-12-0	21.0			59	2-33-0	57.8		
16	1-13-0	21.2			60	2-34-0	57.6	7.85	81.60
17	1-14-0	21.2	6.80	93.10	61	2-35-0	57.5		
18	1-24-0	32.0	7.2	21.25	62	2-36-0	57.5		
19	1-25-0	32.0			63	2-37-0	57.4		
20	1-26-0	32.0			64	2-38-0	57.2		
21	1-27-0	32.0			65	2-39-0	57.3		
22	1-28-0	32.0			66	2-40-0	57.2		
23	1-29-0	32.0			67	2-41-0	57.2		
24	1-30-0	32.0			68	2-42-0	57.2	7.85	141.8
25	1-31-0	32.0			69	2-55-0	71.5	7.70	21.25
26	1-32-0	32.0	7.2	65.8	70	2-56-0	71.8		
27	1-33-0	32.0			71	2-57-0	71.7		
28	1-34-0	31.9			72	2-58-0	71.8		
29	1-35-0	32.0			73	2-59-0	71.9		
30	1-36-0	32.1			74	3- 0-0	71.6		
31	1-37-0	32.0			75	3-01-0	71.2		
32	1-38-0	32.0			76	3-02-0	71.3		
33	1-39-0	32.0			77	3-03-0	71.2	7.70	88.25
34	1-40-0	32.0	7.2	110.9	78	3-04-0	71.1		
35	1-57-0	44.2	7.50	21.25	79	3-05-0	71.2		
36	1-58-0	44.2			80	3-06-0	71.2		
37	1-59-0	44.2			81	3-07-0	71.2		
38	2- 0-0	44.4			82	3-08-0	71.1		
39	2-01-0	44.5			83	3-09-0	71.6		
40	2-02-0	44.6			84	3-10-0	71.8		
41	2-03-0	44.6			85	3-11-0	71.9	7.70	155.4
42	2-04-0	44.6			86	3-41-0	86.0	7.50	21.25
43	2-05-0	44.2	7.55	73.80	87	3-42-0	86.2		
44	2-06-0	44.2			88	3-43-0	86.5		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 46
Temp. water 76°F
August 13, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36368
89	3-44-0	86.5		
90	3-45-0	86.5		
91	3-46-0	86.8		
92	3-47-0	86.5		
93	3-48-0	86.2	7.60	85.80
94	3-49-0	86.2		
95	3-50-0	86.2		
96	3-51-0	86.4		
97	3-52-0	86.3		
98	3-53-0	86.2		
99	3-54-0	86.1		
100	3-55-0	86.5	7.65	150.1
101	4-09-0	102.8	7.9	21.25
102	4-10-0	102.5		
103	4-11-0	102.2		
104	4-12-0	102.0		
105	4-13-0	102.5		
106	4-14-0	102.5		
107	4-15-0	102.5	7.95	81.80
108	4-16-0	102.2		
109	4-17-0	102.5		
110	4-18-0	102.5		
111	4-19-0	102.2		
112	4-20-0	102.5		
113	4-21-0	102.0	8.00	147.00

August 14, 1925.
Orifice used # 43
Temp. water 75°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36368
1	8-07-0	103.0	7.7	21.20
2	8-08-0	103.5		
3	8-09-0	102.0		
4	8-10-0	103.5		
5	8-11-0	103.5		
6	8-12-0	103.0		
7	8-13-0	103.0		
8	8-14-0	102.5		
9	8-15-0	102.0		
10	8-16-0	102.0		
11	8-17-0	101.0	7.80	142.65
12	8-29-0	87.0	7.75	21.30
13	8-30-0	87.5		
14	8-31-0	87.5		
15	8-32-0	87.5		
16	8-33-0	87.8		
17	8-34-0	87.0		
18	8-35-0	87.2		
19	8-36-0	87.5		
20	8-37-0	87.4		
21	8-38-0	87.2		
22	8-39-0	87.5	7.80	133.15
23	8-55-0	71.80	7.75	21.30
24	8-56-0	71.80		
25	8-57-0	71.80		
26	8-58-0	71.80		
27	8-59-0	71.50		
28	9-00-0	71.00		
29	9-01-0	71.00		
30	9-02-0	71.50		
31	9-03-0	71.40		
32	9-04-0	71.20		
33	9-05-0	71.20		
34	9-06-0	71.40		
35	9607-0	71.20	7.80	142.50
36	9-18-0	57.10	7.70	21.30
37	9-19-0	57.50		
38	9-20-0	57.50		
39	9-21-0	57.40		
40	9-32-0	57.20		
41	9-23-0	57.40		
42	9-24-0	57.00	7.70	75.80
43	9-25-0	57.00		
44	9-26-0	57.00		
45	9-27-0	57.10		
46	9-28-0	57.00		
47	9-29-0	57.50		
48	9-30-0	57.60	7.70	130.1
		Crosby 686317		
49	9-41-0	44.0	7.6	21.30
50	9-42-0	44.0		
51	9-43-0	44.0		
52	9-44-0	44.2		
53	9-45-0	44.2		
54	9-46-0	44.1		
55	9-47-0	44.1	7.6	68.80
56	9-48-0	44.0		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

rifice used # 43
emp. water 75°F
August 14, 1925.

un: #	Time :hr-min-sec: Stop watch: # 5	Head : #/□" :Crosby:686317	Water: column: inches	Weight water and can lbs. Fairbanks 38x36268
7	9-49-0	44.0		
8	9-50-0	44.1		
9	9-51-0	44.2		
0	9-52-0	44.3		
1	9-53-0	44.1	7.7	116.30
2	10-01-0	32.4	7.40	21.30
3	10-02-0	32.3		
4	10-03-0	32.3		
5	10-04-0	32.4		
6	10-05-0	32.5		
7	10-06-0	32.8		
8	10-07-0	32.6	7.40	62.00
9	10-08-0	32.7		
0	10-09-0	32.5		
1	10-10-0	32.4		
2	10-11-0	32.3		
3	10-12-0	32.1		
4	10-13-0	32.0	7.40	102.95
5	10-45-0	21.30	7.0	21.30
6	10-46-0	21.30		
7	10-47-0	21.30		
8	10-48-0	21.30		
9	10-49-0	21.30		
0	10-50-0	21.30		
1	10-51-0	21.20	7.00	54.00
2	10-52-0	21.20		
3	10-53-0	21.10		
4	10-54-0	21.10		
5	10-55-0	21.20		
6	10-56-0	21.10		
7	10-57-0	21.00	7.00	86.40

August 15, 1925

rifice used # 39
emp. water 75°F

	8-38-0	22.5	6.05	21.30
	8-39-0	22.5		
	8-40-0	22/4		
	8-41-0	22.2		
5	8-42-0	22.3		
6	8-43-0	22.2	6.05	55.50
7	8-44-0	22.2		
8	8-45-0	22.2		
9	8-46-0	22.2		
10	8-47-0	22.2		

Run: #	Time :hr-min-sec: Stop watch: # 5	Head : #/□" :Crosby: 686317	Water: column: inches	Weight water and can lbs. Fairbanks 38x36268
11	8-48-0	22.3	6.05	90.10
12	9-02-0	32.0	6.60	21.30
13	9-03-0	32.2		
14	9-04-0	32.1		
15	9-05-0	32.2		
16	9-06-0	32.2		
17	9-07-0	32.1	6.60	62.80
18	9-08-0	32.2		
19	9-09-0	32.2		
20	9-10-0	32.2		
21	9-11-0	32.2		
22	9-12-0	32.2	6.55	104.80
23	9-19-0	44.20	7.00	21.30
24	9-20-0	44.20		
25	9-21-0	44.20		
26	9-22-0	44.30		
27	9-23-0	44.20		
28	9-24-0	44.00	7.00	70.00
29	9-25-0	44.00		
30	9-26-0	44.00		
31	9-27-0	44.10		
32	9-28-0	44.20		
33	9-29-0	44.20	7.00	119.10
		Crosby: 818446:		
34	10- 0-0	100.0	7.60	21.30
35	10-01-0	98.0		
36	10-02-0	99.0		
37	10-03-0	98.0		
38	10-04-0	98.0		
39	10-05-0	99.0		
40	10-06-0	98.0		
41	10-07-0	99.0		
42	10-08-0	100.0		
43	10-09-0	99.0	7.70	153.70
44	10-23-0	85.5	7.60	21.30
45	10-24-0	86.5		
46	10-25-0	86.8		
47	10-26-0	85.0		
48	10-27-0	84.0		
49	10-28-0	85.0		
50	10-29-0	84.5		
51	10-30-0	84.5		
52	10-31-0	85.0		
53	10-32-0	84.0		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 39
Temp. water 75°F
August 15, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36368
54	10-33-0	84.0	7.70	157.10
55	11- 0-0	71.5	7.60	21.30
56	11-01-0	71.5		
57	11-02-0	71.5		
58	11-03-0	71.5		
59	11-04-0	71.5		
60	11-05-0	71.5		
61	11-06-0	71.5		
62	11-07-0	71.5		
63	11-08-0	71.5		
64	11-08-0	71.5		
65	11-10-0	71.5	7.70	145.95
66	11-20-0	57.0	7.50	21.30
67	11-21-0	57.0		
68	11-22-0	57.0		
69	11-23-0	57.0		
70	11-24-0	57.0		
71	11-25-0	57.0		
72	11-26-0	57.0		
73	11-27-0	57.0		
74	11-28-0	57.0		
75	11-29-0	57.0		
76	11-30-0	57.0	7.60	132.5

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

rifice used # 76
emp. water 75°F
August 5, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
	0	5.00				0	5.00		
	8-42-0	34.0	7.00	5.38	44	10-08-0	34.0		
	8-44-0	33.9			45	10-10-0	34.0		
	8-46-0	33.8			46	10-12-0	34.0	7.00	44.52
	8-48-0	33.9			47	10-32-0	24.5	6.7	5.38
	8-50-0	33.8			48	10-34-0	24.5		
	8-52-0	33.8			49	10-36-0	24.5		
	8-54-0	33.8			50	10-38-0	24.5		
	8-56-0	33.8			51	10-40-0	24.4		
	8-58-0	33.8			52	10-42-0	24.4		
0	9- 0-0	34.0			53	10-44-0	24.4		
1	9-02-0	34.0			54	10-46-0	24.4		
2	9-04-0	34.0			55	10-48-0	24.8		
3	9-06-0	34.0			56	10-50-0	25.0		
4	9-08-0	33.9			57	10-52-0	24.8		
5	9-10-0	34.0			58	10-54-0	24.7		
6	9-12-0	34.0	7.00	18.45	59	10-56-0	24.6		
7	9-14-0	34.0			60	10-58-0	24.5		
8	9-16-0	33.9			61	11- 0-0	24.5		
9	9-18-0	33.8			62	11-02-0	24.4	6.7	16.45
0	9-20-0	33.8			63	11-04-0	24.5		
1	8-22-0	33.8			64	11-06-0	24.7		
2	9-24-0	33.8			65	11-08-0	24.8		
3	9-26-0	33.8			66	11-10-0	24.8		
4	9-28-0	33.8			67	11-12-0	24.8		
5	9-30-0	33.9			68	11-14-0	24.8		
6	9-32-0	33.6			69	11-16-0	24.8		
7	9-34-0	33.9			70	11-18-0	24.8		
8	9-36-0	34.0			71	11-20-0	24.8		
9	9-38-0	34.0			72	11-22-0	24.8		
0	9-40-0	34.0			73	11-24-0	24.8		
1	9-42 -0	33.8	7.00	31.52	74	11-26-0	24.7		
2	9-44-0	33.8			75	11-28-0	24.6		
3	9-46-0	33.9			76	11-30-0	24.6		
4	9-48-0	33.9			77	11-32-0	24.5	6.7	27.52
5	9-50-0	33.9			78	11-34-0	24.5		
6	9-52-0	33.8			79	11-36-0	24.4		
7	9-54-0	33.8			80	11-38-0	24.3		
8	9-56-0	33.8			81	11-40-0	24.3		
9	9-58-0	33.8			82	11-42-0	24.2		
0	10- 0-0	33.8			83	11-44-0	24.2		
1	10-02-0	33.8			84	11-46-0	24.2		
2	10-04-0	33.8			85	11-48-0	24.1		
3	10-06-0	34.0			86	11-50-0	24.1		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 76
Temp. water 75°F
August 5, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		0	5.00	
87	11-52-0	24.1		
88	11-54-0	24.0		
89	11-56-0	24.0		
90	11-58-0	24.0		
91	12-0-0	24.0		
92	12-02-0	24.2	6.7	38.6
93	12-04-0	24.5		
94	12-06-0	24.6		
95	12-08-0	24.7		
96	12-10-0	24.6		
97	12-12-0	24.6	6.7	42.32

Orifice used # 60
Temp water 73°F
August 7, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
1	8-04-0	34.0	6.9	5.20
2	8-06-0	33.8		
3	8-08-0	33.5		
4	8-10-0	33.8		
5	8-12-0	33.5		
6	8-14-0	33.4		
7	8-16-0	33.5		
8	8-18-0	33.3		27.15
9	8-20-0	33.5		
10	8-22-0	33.8		
11	8-24-0	33.5		
12	8-26-0	33.5		
13	8-28-0	33.3		
14	8-30-0	33.8		
15	8-31-0	34.1	6.9	47.60
16	8-32-0	33.9	6.9	49.15
17	8-46-0	43.8	7.2	21.18
18	8-47-0	43.8		
19	8-48-0	43.8		
20	8-49-0	43.7		
21	8-50-0	43.5		
22	8-51-0	43.7		
23	8-52-0	43.6		
24	8-53-0	43.7		
25	8-54-0	43.7		
26	8-55-0	44.2		
27	8-56-0	43.1		
28	8-57-0	42.8		
29	8-58-0	43.8		
30	8-59-0	44.0		
31	9-0-0	43.9		
32	9-01-0	43.8	7.2	48.00
33	9-02-0	44.0		
34	9-03-0	44.1		
35	9-04-0	43.6		
36	9-05-0	43.4		
37	9-06-0	43.6		
38	9-07-0	43.6		
39	9-08-0	43.8		
40	9-09-0	44.0		
41	9-10-0	43.9		
42	9-11-0	43.9		
43	9-12-0	43.8		
44	9-13-0	43.9		
45	9-14-0	44.0		
46	9-15-0	44.1		
47	9-16-0	44.0	7.2	74.90
48	9-38-0	54.0	7.40	21.20
49	9-39-0	54.1		
50	9-30-0	54.5		
51	9-31-0	54.1		
52	9-32-0	54.0		
53	9-33-0	54.1		
54	9-34-0	54.0		
55	9-35-0	53.8		
56	9-36-0	53.4		
47	9-37-0	53.6		
48	9-38-0	54.0		
49	9-39-0	54.8		
50	9-40-0	55.0		
51	9-41-0	54.9		
52	9-42-0	54.9		
53	9-43-0	55.0	7.45	51.20
54	9-44-0	55.1		
55	9-45-0	54.9		
56	9-46-0	54.8		
57	9-47-0	54.8		
58	9-48-0	54.9		
59	9-49-0	54.9		
60	9-50-0	54.6		
61	9-51-0	54.3		
62	9-52-0	54.1		
63	9-53-0	54.0		
64	9-54-0	53.8		
65	9-55-0	54.0		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 7, 1926

Orifice used # 60
Temp. water 73°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36368
		0	5.00				0	5.00	
66	9-56-0	54.3			110	10-54-0	74.8		
67	9-57-0	54.6			111	10-55-0	74.8		
68	9-58-0	54.5	7.45	81.36	112	10-56-0	75.0		
69	10-06-0	64.0	7.60	21.20	113	10-57-0	75.2		
70	10-07-0	64.0			114	10-58-0	74.3		
71	10-08-0	63.8			115	10-59-0	74.7	7.75	56.35
72	10-09-0	64.0			116	11-0-0	74.6		
73	10-10-0	63.9			117	11-01-0	74.8		
74	10-11-0	63.8			118	11-02-0	75.0		
75	10-12-0	63.2	5		119	11-03-0	75.1		
76	10-13-0	63.4			120	11-04-0	75.2		
77	10-14-0	63.8			121	11-05-0	75.0		
78	10-15-0	64.2			122	11-06-0	74.8		
79	10-16-0	64.1			123	11-07-0	74.2		
80	10-17-0	64.4			124	11-08-0	74.1		
81	10-18-0	64.1			125	11-09-0	74.0		
82	10-19-0	64.0			126	11-10-0	74.3		
83	10-20-0	64.0			127	11-11-0	74.5		
84	10-21-0	64.1	7.60	54.00	128	11-12-0	74.5		
85	10-22-0	64.5			129	11-13-0	74.5		
86	10-23-0	64.2			130	11-14-0	74.6	7.75	91.55
87	10-24-0	64.1			131	11-24-0	85.0	7.90	21.22
88	10-25-0	64.0			132	11-25-0	84.9		
89	10-26-0	64.0			133	11-26-0	84.7		
90	10-27-0	64.1			134	11-27-0	83.0		
91	10-28-0	64.2			135	11-28-0	83.5		
92	10-29-0	64.0			136	11-29-0	83.5		
93	10-30-0	63.9			137	11-30-0	84.8		
94	10-31-0	64.0			138	11-31-0	85.2		
95	10-32-0	64.0			139	11-32-0	85.3		
96	10-33-0	64.0			140	11-33-0	85.2		
97	10-34-0	64.0			141	11-34-0	85.4		
98	10-35-0	64.0			142	11-35-0	85.2		
99	10-36-0	64.0	7.65	86.50	143	11-36-0	85.0		
100	10-44-0	74.8	7.75	21.22	144	11-37-0	84.9		
101	10-45-0	74.5			145	11-38-0	84.9		
102	10-46-0	74.3			146	11-39-0	84.9	7.90	58.60
103	10-47-0	73.0			147	11-40-0	84.7		
104	10-48-0	74.1			148	11-41-0	84.5		
105	10-49-0	74.8			149	11-42-0	84.5		
106	10-50-0	75.0			150	11-43-0	84.1		
107	10-51-0	75.0			151	11-44-0	84.4		
108	10-52-0	74.8			152	11-45-0	84.5		
109	10-53-0	74.8			153	11-46-0	84.2		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 60
Temp. water 73°F

Howell, R. S.
August 7, 1925.

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
154	11-47-0	84.0			196	1-31-0	104.0		
155	11-48-0	84.5			197	1-32-0	104.2		
156	11-49-0	84.9			198	1-33-0	104.0		
157	11-50-0	84.7			199	1-34-0	105.0		
158	11-51-0	84.3			200	1-35-0	104.0		
159	11-52-0	84.0			201	1-36-0	104.2		
160	11-53-0	83.5			202	1-37-0	105.0		
161	11-54-0	84.0	7.90	95.98	203	1-38-0	104.8		
	Temp. water 74°F				204	1-39-0	104.5		
162	12-36-0	94.8	8.10	21.22	205	1-40-0	104.8		
163	12-37-0	95.0			206	1-41-0	104.5		
164	12-38-0	95.0			207	1-42-0	104.2		
165	12-39-0	94.5			208	1-43-0	104.8	7.90	62.65
166	12-40-0	94.8			209	1-44-0	105.0		
167	12-41-0	94.9			210	1-45-0	104.6		
168	12-42-0	94.9			211	1-46-0	104.5		
169	12-43-0	94.1			212	1-47-0	104.9		
170	12-44-0	94.0			213	1-48-0	104.5		
171	12-45-0	94.0			214	1-49-0	104.8		
172	12-46-0	94.0			215	1-50-0	104.2		
173	12-47-0	93.8			216	1-51-0	104.5		
174	12-48-0	93.8			217	1-52-0	104.7		
175	12-49-0	94.3			218	1-53-0	104.6		
176	12-50-0	94.0			219	1-54-0	105.0		
177	12-51-0	95.0	8.15	60.60	220	1-55-0	104.5		
178	12-52-0	95.8			221	1-56-0	104.4		
179	12-53-0	95.0			222	1-57-0	104.6		
180	12-54-0	94.8			223	1-58-0	104.4	7.95	104.42
181	12-55-0	94.0			Orifice used # 55				
182	12-56-0	94.0			Temp. water 75°F				
183	12-57-0	94.1			224	2-30-0	104.0	7.70	21.22
184	12-58-0	93.8			225	2-31-0	103.8		
185	12-59-0	93.8			226	2-32-0	104.0		
186	1-0-0	93.8			227	2-33-0	104.1		
187	1-01-0	93.9			228	2-34-0	104.9		
188	1-02-0	93.9			229	2-35-0	104.5		
189	1-03-0	94.0			230	2-36-0	104.1		
190	1-04-0	94.1			231	2-37-0	104.0		
191	1-05-0	94.0			232	2-38-0	104.1		
192	1-06-0	94.0	8.20	100.20	233	2-39-0	104.0		
193	1-38-0	104.5	7.85	21.22	234	2-40-0	104.1		
194	1-39-0	104.5			235	2-41-0	104.2		
195	1-30-0	104.2			236	2-42-0	104.3		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 7, 1925

Orifice used # 55
Temp. water 75°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
237:	2-43-0	104.2			281:	3-38-0	95.2		
238:	2-44-0	104.2			282:	3-39-0	95.1		
239:	2-45-0	104.5	7.75:	83.50	283:	3-40-0	95.2		
240:	2-46-0	104.7			284:	3-41-0	95.1		
241:	2-47-0	104.5			285:	3-42-0	95.2	7.95:	143.60
242:	2-48-0	104.1			286:	3-54-0	84.5	7.90:	21.22
243:	2-49-0	104.1			287:	3-55-0	84.5		
244:	2-50-0	104.3			288:	3-56-0	84.1		
245:	2-51-0	104.4			289:	3-57-0	84.5		
246:	2-52-0	104.0			290:	3-58-0	83.8		
247:	2-53-0	104.2			291:	3-59-0	84.2		
248:	2-54-0	104.0			292:	4-0-0	84.5		
249:	2-55-0	104.5			293:	4-01-0	84.4		
250:	2-56-0	104.6			294:	4-02-0	84.9		
251:	2-57-0	104.4			295:	4-03-0	85.0		
252:	2-58-0	105.0			296:	4-04-0	84.9		
253:	2-59-0	104.5			297:	4-05-0	84.8		
254:	3-0-0	104.2	7.80:	145.80	298:	4-06-0	84.8		
255:	3-12-0	95.2	7.85:	21.22	299:	4-07-0	84.8		
256:	3-13-0	95.3			300:	4-08-0	84.9		
257:	3-14-0	95.9			301:	4-09-0	85.0	8.00:	78.60
258:	3-15-0	95.7			302:	4-10-0	84.9		
259:	3-16-0	95.4			303:	4-11-0	84.5		
260:	3-17-0	95.2			304:	4-12-0	84.0		
261:	3-18-0	95.4			305:	4-13-0	84.5		
262:	3-19-0	95.2			306:	4-14-0	84.5		
263:	3-20-0	95.5			307:	4-15-0	84.5		
264:	3-21-0	95.1			308:	4-16-0	84.5		
265:	3-22-0	95.2			309:	4-17-0	84.5		
266:	3-23-0	95.7			310:	4-18-0	84.5		
267:	3-24-0	95.3			311:	4-19-0	84.5		
268:	3-25-0	95.3			312:	4-30-0	84.7		
269:	3-26-0	95.0			313:	4-31-0	84.5		
270:	3-27-0	95.2	7.90:	82.3	314:	4-32-0	84.0		
271:	3-28-0	95.5			315:	4-33-0	84.2		
272:	3-29-0	95.2			316:	4-34-0	84.5	8.10:	136.22
273:	3-30-0	94.8			317:	4-38-0	74.2	8.05:	21.22
274:	3-31-0	95.5			318:	4-39-0	74.5		
275:	3-32-0	95.6			319:	4-40-0	74.2		
276:	3-33-0	95.5			320:	4-41-0	74.0		
277:	3-34-0	95.8			321:	4-42-0	74.8		
278:	3-35-0	95.7			322:	4-43-0	74.2		
279:	3-36-0	95.5			323:	4-44-0	74.5		
280:	3-37-0	95.2			324:	4-45-0	74.4		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 55
Temp. water 75°F
August 7, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby #818446	Water column inches	Weight water and can lbs. Fairbanks 38x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby #818446	Water column inches	Weight water and can lbs. Fairbanks 38x36268
25	4-46-0	74.8			19	8-18-0	64.4		
26	4-47-0	74.1			20	8-19-0	64.0		
27	4-48-0	74.8			21	8-20-0	64.1		
28	4-49-0	75.1			22	8-21-0	64.2		
29	4-50-0	75.0			23	8-22-0	64.3		
30	4-51-0	75.0			24	8-23-0	64.4		
31	4-53-0	74.2	8.15	75.00	25	8-24-0	64.6		
32	4-52-0	74.7			26	8-25-0	64.5		
33	4-54-0	74.5			27	8-26-0	64.0		
34	4-55-0	74.4			28	8-27-0	64.3		
35	4-56-0	74.4			29	8-28-0	64.8		
36	4-57-0	74.8			30	8-29-0	65.0		
37	4-58-0	74.2			31	8-30-0	65.2	7.40	122.08
38	4-59-0	74.8			32	8-38-0	54.5	7.30	21.40
39	5- 0-0	74.5			33	8-39-0	54.3		
40	5-01-0	74.0			34	8-40-0	54.0		
41	5-02-0	74.2			35	8-41-0	54.0		
43	5-03-0	74.2			36	8-42-0	53.8		
43	5-04-0	74.0			37	8-43-0	53.9		
44	5-05-0	74.5			38	8-44-0	54.3		
45	5-06-0	74.8			39	8-45-0	54.7		
46	5-07-0	75.0			40	8-46-0	55.0		
47	5-08-0	74.8	8.20	129.20	41	8-47-0	55.0		
					42	8-48-0	53.8		

August 8, 1925.

Orifice used # 55
Temp. water 73.5°F

					43	8-49-0	53.5		
					44	8-50-0	54.5		
					45	8-51-0	55.0		
	8-0-0	64.2	7.40	81.30	46	8-52-0	55.0		
	8-01-0	64.0			47	8-53-0	54.9	7.30	67.5
	8-02-0	64.1			48	8-54-0	54.9		
	8-03-0	64.2			49	8-55-0	54.9		
	8-04-0	64.3			50	8-56-0	54.8		
	8-05-0	64.1			51	8-57-0	54.8		
	8-06-0	64.0			52	8-58-0	54.7		
	8-07-0	64.3			53	8-59-0	54.7		
	8-08-0	64.6			54	9- 0-0	54.5		
0	8-09-0	64.6			55	9-01-0	54.2		
1	8-10-0	64.5			56	9-02-0	54.2		
2	8-11-0	64.4			57	9-03-0	54.3		
3	8-12-0	64.4			58	9-04-0	54.4		
4	8-13-0	64.1			59	9-05-0	54.3		
5	8-14-0	64.2			60	9-06-0	54.1		
6	8-15-0	64.5	7.40	71.5	61	9-07-0	54.2		
7	8-16-0	64.7			62	9-08-0	54.1	7.30	113.50
8	8-17-0	64.8							

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 55
Temp. water 74°F

Howell, R. S.
August 8, 1925.

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
63	9-20-0	45.0	7.20	21.30	107	10-14-0	35.0		
64	9-21-0	44.7			108	10-15-0	34.9	7.00	57.70
65	9-22-0	44.6			109	10-16-0	34.9		
66	9-23-0	44.7			110	10-17-0	34.8		
67	9-24-0	44.8			111	10-18-0	34.6		
68	9-25-0	44.2			112	10-19-0	34.3		
69	9-26-0	43.9			113	10-20-0	34.1		
70	9-27-0	43.9			114	10-21-0	33.9		
71	9-28-0	44.1			115	10-22-0	34.3		
72	9-29-0	44.7			116	10-23-0	34.5		
72	9-30-0	45.1			117	10-24-0	34.3		
73	9-31-0	45.1			118	10-25-0	34.2		
74	9-32-0	45.1			119	10-26-0	34.1		
75	9-33-0	45.0			120	10-27-0	34.2		
76	9-34-0	44.9			121	10-28-0	34.2		
77	9-35-0	44.8	7.20	62.80	122	10-29-0	33.9		
78	9-36-0	44.8			123	10-30-0	34.3	7.00	94.35
79	9-37-0	44.8			124	10-42-0	24.0	6.60	21.20
80	9-38-0	44.9			125	10-43-0	24.6		
81	9-39-0	44.9			126	10-44-0	25.0		
82	9-40-0	44.7			127	10-45-0	24.9		
83	9-41-0	44.6			128	10-46-0	25.0		
84	9-42-0	44.6			129	10-47-0	25.1		
85	9-43-0	44.6			130	10-48-0	25.2		
86	9-44-0	44.6			131	10-49-0	25.1		
87	9-45-0	44.7			132	10-50-0	24.9		
88	9-46-0	44.8			133	10-51-0	24.8		
89	9-47-0	45.0			134	10-52-0	24.7		
90	9-48-0	44.7			135	10-53-0	24.7		
91	9-49-0	44.3			136	10-54-0	24.8		
92	9-50-0	44.1	7.20	104.75	137	10-55-0	24.8		
93	10-0-0	34.2	7.00	21.25	138	10-56-0	24.8		
94	10-01-0	34.0			139	10-57-0	24.8	6.60	52.20
95	10-02-0	33.7			140	10-58-0	24.9		
96	10-03-0	33.7			141	10-59-0	25.0		
97	10-04-0	33.8			142	11-00-0	25.1		
98	10-05-0	33.9			143	11-01-0	25.2		
99	10-06-0	34.1			144	11-02-0	25.2		
100	10-07-0	34.4			145	11-03-0	25.1		
101	10-08-0	34.6			146	11-04-0	25.0		
102	10-09-0	34.7			147	11-05-0	25.0		
103	10-10-0	34.7			148	11-06-0	24.9		
104	10-11-0	34.8			149	11-07-0	24.8		
105	10-12-0	34.9			150	11-08-0	24.7		
106	10-13-0	34.9			151	11-09-0	24.6		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R.S.

Orifice used # 55
Temp. water 74°F
August 8, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
152	11-10-0	24.6			36	2-46-0	59.5		
153	11-11-0	24.7			37	2-47-0	59.5		
154	11-12-0	24.8	6.65	83.80	38	2-48-0	59.4		
					39	2-49-0	59.2		
		August 11, 1925			40	2-50-0	59.2		
Orifice used # 53					41	2-51-0	59.7		
Temp. water 75°F					42	2-52-0	59.9	8.00	65.70
1	1-55-0	46.0	8.0	21.2	43	2-53-0	59.9		
2	1-56-0	46.0			44	2-54-0	59.9		
3	1-57-0	46.0			45	2-55-0	59.8		
4	1-58-0	46.1			46	2-56-0	59.7		
5	1-59-0	46.7			47	2-57-0	59.9		
6	2- 0-0	46.7			48	2-58-0	59.8		
7	2-01-0	46.6			49	2-59-0	59.8		
8	2-02-0	46.4			50	3- 0-0	59.5		
9	2-03-0	46.3			51	3-01-0	59.3		
10	2-04-0	46.5			52	3-02-0	59.3	8.05	110.55
11	2-05-0	46.8			53	3-14-0	74.0	7.85	21.25
12	2-06-0	46.9			54	3-15-0	74.0		
13	2-07-0	46.8			55	3-16-0	73.9		
14	2-08-0	46.7			56	3-17-0	73.9		
15	2-09-0	46.6			57	3-18-0	73.9		
16	2-10-0	46.9	8.05	79.80	58	3-19-0	73.8		
17	2-11-0	46.9			59	3-20-0	73.6		
18	2-12-0	46.9			60	3-21-0	73.4		
19	2-13-0	46.8			61	3-22-0	73.5		
20	2-14-0	46.9			62	3-23-0	73.8		
21	2-15-0	46.9			63	3-24-0	73.9	7.85	70.50
22	2-16-0	46.6			64	3-25-0	73.9		
23	2-17-0	46.6			65	3-26-0	73.7		
24	2-18-0	46.8			66	3-27-0	73.6		
25	2-19-0	46.9			67	3-28-0	73.5		
26	2-20-0	46.8			68	3-29-0	73.4		
27	2-21-0	46.8			69	3-30-0	73.2		
28	2-22-0	46.6			70	3-31-0	73.2		
29	2-23-0	46.8			71	3-32-0	73.5		
30	2-24-0	46.5			72	3-33-0	73.3		
31	2-25-0	46.5	8.10	138.7	73	3-34-0	73.1	7.85	120.00
		Crosby 818446			74	3-48-0	88.8	8.0	21.25
					75	3-49-0	88.8		
32	2-42-0	59.5	7.90	21.25	76	3-50-0	88.6		
33	2-43-0	59.4			77	3-51-0	88.2		
34	2-44-0	59.8			78	3-52-0	88.2		
35	2-45-0	59.7			79	3-53-0	88.4		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.

Orifice used # 53
Temp. Water 75°F
August 11, 1925

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
80	3-54-0	88.2		
81	3-55-0	88.2		
82	3-56-0	88.1		
83	3-57-0	88.2		
84	3-58-0	88.2	8.05	75.00
85	3-59-0	88.1		
86	4- 0-0	88.2		
87	4-01-0	88.5		
88	4-02-0	88.8		
89	4-03-0	88.4		
90	4-04-0	88.6		
91	4-05-0	88.5		
92	4-06-0	88.4		
93	4-07-0	88.0		
94	4-08-0	88.5	8.10	129.20
95	4-19-0	104.5	8.20	21.25
96	4-20-0	104.0		
97	4-21-0	104.5		
98	4-22-0	104.0		
99	4-23-0	104.0		
100	4-24-0	104.0		
101	4-25-0	104.0		
102	4-26-0	104.0		
103	4-27-0	104.0		
104	4-28-0	104.0		
105	4-29-0	104.0	8.25	29.80
106	4-30-0	103.5		
107	4-31-0	104.5		
108	4-32-0	103.5		
109	4-33-0	104.0		
110	4-34-0	104.5		
111	4-35-0	104.0		
112	4-36-0	104.5		
113	4-37-0	104.5		
114	4-38-0	103.5		
115	4-39-0	104.5	8.30	138.15

August 12, 1925

Orifice used # 50
Temp water 75°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268
1	8-19-0	101.5	7.50	21.15
2	8-20-0	103.0		
3	8-21-0	103.0		
4	8-22-0	103.0		
5	8-23-0	102.0		
6	8-24-0	101.8		
7	8-25-0	101.6		
8	8-26-0	101.8		
9	8-27-0	101.8		
10	8-28-0	101.8		
11	8-29-0	102.0	7.50	96.50
12	8-30-0	102.0		
13	8-31-0	102.0		
14	8-32-0	102.0		
15	8-33-0	101.8		
16	8-34-0	102.5	7.55	134.50
17	8-46-0	88.5	7.50	21.5
18	8-47-0	88.4		
19	8-48-0	88.8		
20	8-49-0	88.6		
21	8-50-0	88.6		
22	8-51-0	88.5		
23	8-52-0	88.5		
24	8-53-0	88.2		
25	8-54-0	88.0	7.50	77.4
26	8-55-0	88.2		
27	8-56-0	88.0		
28	8-57-0	88.2		
29	8-58-0	88.9		
30	8-59-0	88.8		
31	9- 0-0	88.9		
32	9-01-0	88.8		
33	9-02-0	88.9	7.50	133.75
34	9-14-0	73.4	7.35	21.35
35	9-15-0	73.2		
36	9-16-0	73.5		
37	9-17-0	73.4		
38	9-18-0	73.2		
39	9-20-0	73.0		
40	9-21-0	73.2		
41	9-22-0	73.4	7.35	72.40
42	9-23-0	73.5		
43	9-24-0	73.2		
44	9-25-0	73.2		
45	9-26-0	73.2		
46	9-27-0	73.2		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 12, 1925.

Orifice used # 50
Temp. water 75°F

Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 818446	Water column inches	Weight water and can lbs. Fairbanks 28x36268	Run #	Time hr-min-sec Stop watch # 5	Head #/□" Crosby 686317	Water column inches	Weight water and can lbs. Fairbanks 28x36268
47	9-28-0	73.6			90	10-42-0	34.3		
48	9-29-0	73.4			91	10-43-0	34.2		
49	9-30-0	73.2	7.35	123.45	92	10-44-0	34.2		
50	9-42-0	59.8	7.20	21.25	93	10-45-0	34.0		
51	9-43-0	59.8			94	10-46-0	34.0		
52	9-44-0	59.7			95	10-47-0	34.0	7.10	60.25
53	9-45-0	59.5			96	10-48-0	34.0		
54	9-46-0	59.4			97	10-49-0	34.2		
55	9-47-0	59.2			98	10-50-0	34.3		
56	9-48-0	59.2			99	10-51-0	34.4		
57	9-49-0	59.0			100	10-52-0	34.3		
58	9-50-0	59.0	7.20	67.20	101	10-53-0	34.3		
59	9-51-0	59.0			102	10-54-0	34.2		
60	9-52-0	59.2			103	10-55-0	34.0		
61	9-53-0	59.0			104	10-56-0	34.2	7.00	99.50
62	9-54-0	59.0			105	11-06-0	22.2	6.35	21.25
63	9-55-0	59.0			106	11-07-0	22.2		
64	9-56-0	59.0			107	11-08-0	22.3		
65	9-57-0	59.0			108	11-09-0	22.2		
66	9-58-0	59.0	7.20	113.20	109	11-10-0	22.2		
		Crosby 686317			110	11-11-0	22.1		
					111	11-12-0	22.2		
67	10-12-0	46.3			112	11-13-0	22.2		
68	10-13-0	46.2			113	11-14-0	22.2		
69	10-14-0	46.4			114	11-15-0	22.1		
70	10-15-0	46.5			115	11-16-0	22.1	6.30	56.00
71	10-16-0	46.4			116	11-17-0	22.1		
72	10-17-0	46.2			117	11-18-0	22.2		
73	10-18-0	46.1			118	11-19-0	22.3		
74	10-19-0	46.0			119	11-20-0	22.5		
75	10-20-0	46.0			120	11-21-0	22.2		
76	10-21-0	46.0	7.6	66.80	121	11-22-0	22.0		
77	10-22-0	46.0			122	11-33-0	22.0		
78	10-23-0	46.1			123	11-34-0	22.0		
79	10-24-0	46.1			124	11-35-0	22.0		
80	10-25-0	46.1			125	11-36-0	22.1	6.15	91.00
81	10-26-0	46.3							
82	10-27-0	46.2							
83	10-28-0	46.5							
84	10-29-0	46.4							
85	10-30-0	46.7	7.6	112.40					
86	10-38-0	34.2	7.15	21.25					
87	10-39-0	34.2							
88	10-40-0	34.2							
89	10-41-0	34.3							

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 13, 1925

Orifice used # 50
Temp. water 76°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total inches of mercury The Meriam Company: Cleveland, Ohio	Water column inches	Weight water and can lbs. Fairbanks 28x36268
1	1-02-0	13.65	13.20	26.85	8.20	21.25
2	1-03-0	13.65	13.20	26.85		
3	1-04-0	13.65	13.20	26.85		
4	1-05-0	13.70	13.25	26.95		
5	1-06-0	13.67	13.22	26.89		
6	1-07-0	13.71	13.26	26.97		
7	1-08-0	13.73	13.28	27.01		
8	1-09-0	13.63	13.18	26.81		
9	1-10-0	13.60	13.15	26.75		
10	1-11-0	13.70	13.25	26.95		
11	1-12-0	13.71	13.26	26.97	8.20	48.8
12	1-13-0	13.67	13.22	26.89		
13	1-14-0	13.70	13.25	26.95		
14	1-15-0	13.74	13.28	27.03		
15	1-16-0	13.73	13.28	27.01		
16	1-17-0	13.67	13.22	26.89		
17	1-18-0	13.65	13.20	26.85		
18	1-19-0	13.65	13.20	26.85		
19	1-20-0	13.66	13.21	26.87		
20	1-21-0	13.66	13.21	26.87		
21	1-22-0	13.65	13.20	26.85	8.20	76.60
22	1-29-0	8.57	8.42	16.99	8.00	5.22
23	1-30-0	8.55	8.40	16.95		
24	1-31-0	8.59	8.44	17.03		
25	1-32-0	8.61	8.46	17.07		
26	1-33-0	8.63	8.48	17.11		
27	1-34-0	8.55	8.40	16.95		
28	1-35-0	8.63	8.48	17.11		
29	1-36-0	8.61	8.46	17.07		
30	1-37-0	8.63	8.48	17.11		
31	1-38-0	8.65	8.50	17.15		
32	1-39-0	8.61	8.46	17.07	8.00	27.3
33	1-40-0	8.59	8.44	17.03		
34	1-41-0	8.60	8.45	17.05		
35	1-42-0	8.55	8.40	16.95		
36	1-43-0	8.60	8.45	17.05		
37	1-44-0	8.60	8.45	17.05		
38	1-45-0	8.60	8.45	17.05		
39	1-46-0	8.60	8.45	17.05		
40	1-47-0	8.61	8.46	17.07		
41	1-48-0	8.59	8.44	17.03		
42	1-49-0	8.61	8.46	17.07	8.00	49.70
43	1-55-0	5.45	5.40	10.85	7.80	5.28
44	1-56-0	5.50	5.45	10.95		
45	1-57-0	5.47	5.42	10.89		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 12, 1925.

Orifice used # 50
Temp. water 76°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		inches of mercury The Mericam Company Cleveland, Ohio				
46	1-58-0	5.45	5.40	10.85		
47	1-59-0	5.45	5.40	10.85		
48	2- 0-0	5.46	5.41	10.87		
49	2-01-0	5.47	5.42	10.89		
50	2-02-0	5.46	5.41	10.87		
51	2-03-0	5.45	5.40	10.85		
52	2-04-0	5.43	5.38	10.81		
53	2-05-0	5.45	5.40	10.85	7.80	23.28
54	2-06-0	5.45	5.40	10.85		
55	2-07-0	5.47	5.42	10.89		
56	2-08-0	5.43	5.38	10.81		
57	2-09-0	5.45	5.40	10.85		
58	2-10-0	5.43	5.38	10.81		
59	2-11-0	5.43	5.38	10.81		
60	2-12-0	5.46	5.41	10.87		
61	2-13-0	5.47	5.42	10.89		
62	2-14-0	5.47	5.42	10.89		
63	2-15-0	5.44	5.39	10.83	7.80	41.25
		feet of water water column				
64	2-30-0	0.32	8.52	8.84	8.70	5.28
65	2-31-0	0.32	8.51	8.83		
66	2-32-0	0.32	8.49	8.81		
67	2-33-0	0.32	8.47	8.79		
68	2-34-0	0.32	8.48	8.80		
69	2-35-0	0.32	8.47	8.79		
704	2-36-0	0.32	8.54	8.86		
71	2-37-0	0.32	8.57	8.89		
72	2-38-0	0.32	8.57	8.89		
73	2-39-0	0.32	8.53	8.85		
74	2-40-0	0.32	8.45	8.77	8.70	20.10
75	2-41-0	0.32	8.42	8.74		
76	2-42-0	0.32	8.40	8.72		
77	2-43-0	0.32	8.44	8.76		
78	2-44-0	0.32	8.46	8.78		
79	2-45-0	0.32	8.52	8.84		
80	2-46-0	0.32	8.58	8.90		
81	2-47-0	0.32	8.63	8.95		
82	2-48-0	0.32	8.64	8.91		
83	2-49-0	0.32	8.61	8.93		
84	2-50-0	0.32	8.55	8.87	8.60	35.18
Temp.	water 77°F			Diff.		Howe -28x1866
85	3-02-0	0.35	4.16		7.70	2.70
86	3-03-0	0.35	4.16			
87	3-04-0	0.35	4.16			

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 50
Temp. water 77°F

Howell, R. S.
August 12,1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Diff. feet of water water column	Water column inches	Weight water and can lbs. Howe 28x1866
88	3-05-0	0.35	4.16			
89	3-06-0	0.35	4.16			
90	3-07-0	0.35	4.16			
91	3-07-24.6	0.35	4.16			
		Av. 0.35	Av. 4.16	3.81	7.70	8.47
92	3-13-0	0.35	4.16		7.70	2.70
93	3-14-0	0.35	4.16			
94	3-15-0	0.35	4.16			
95	3-16-0	0.35	4.16			
96	3-17-0	0.35	4.16			
97	3-18-0	0.35	4.16			
98	3-18-24.4	0.35	4.16			
		Av. 0.35	Av. 4.16	3.81	7.70	8.47
99	3-27-0	0.36	2.13		7.25	2.70
100	3-28-0	0.36	2.13			
101	3-29-0	0.36	2.13			
102	3-30-0	0.36	2.13			
103	3-31-0	0.36	2.13			
104	3-32-0	0.36	2.13			
105	3-33-0	0.36	2.14			
106	3-34-15	0.36	2.14		7.20	8.47
107	3-42-0	0.36	2.13		7.20	2.70
108	3-43-0	0.36	2.13			
109	3-44-0	0.36	2.13			
110	3-45-0	0.36	2.13			
111	3-46-0	0.36	2.13			
112	3-47-0	0.36	2.13			
113	3-48-0	0.36	2.13			
114	3-49-16	0.36	2.13			
		Av. 0.36	Av. 2.13	1.77	7.20	8.42
115	3-56-0	0.36	2.13		7.15	2.70
116	3-57-0	0.36	2.13			
117	3-58-0	0.36	2.13			
118	3-59-0	0.36	2.13			
119	4-0-0	0.36	2.13			
120	4-01-0	0.36	2.13			
121	4-02-0	0.36	2.13			
122	4-03-30	0.36	2.13			
		Av. 0.36	Av. 2.13	1.77	7.10	8.47

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 13, 1925

Orifice used # 46
Temp. water 76°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Manometer Reading Right	Diff. feet of water water column	Water column inches	Weight water and can lbs. Howe 28x1866
1	8-0-0	0.36	2.02		6.20	2.70
2	8-01-0	0.36	2.02			
3	8-02-0	0.36	2.02			
4	8-03-0	0.36	2.02			
5	8-04-0	0.36	2.02			
6	8-05-0	0.36	2.02			
7	8-06-47.6	0.36	2.02			
		Av. 0.36	Av. 2.02	1.66	6.20	8.47
8	8-10-0	0.36	2.03		6.00	2.70
9	8-11-0	0.36	2.03			
10	8-12-0	0.36	2.03			
11	8-13-0	0.36	2.03			
12	8-14-0	0.36	2.03			
13	8-15-0	0.36	2.03			
14	8-15-47.6	0.36	2.03			
		Av. 0.36	Av. 2.03	1.67	5.95	8.47
15	8-20-0	0.35	4.10		6.20	2.70
16	8-21-0	0.35	4.10			
17	8-22-0	0.35	4.10			
18	8-23-0	0.35	4.10			
19	8-24-11.4	0.35	4.10			
		Av. 0.35	4.10	3.75	6.20	8.47
20	8-30-0	0.35	4.10		6.20	2.70
21	8-31-0	0.35	4.10			
22	8-32-0	0.35	4.10			
23	8-33-0	0.35	4.10			
24	8-34-11.8	0.35	4.10			
		Av. 0.35	4.10	3.75	6.20	8.47 Fairbanks 28x36268
25	9-34-0	0.32	8.42		7.00	5.18
26	9-35-0	"	8.42			
27	9-36-0	"	8.54			
28	9-37-0	"	8.53			
29	9-38-0	"	8.52			
30	9-39-0	"	8.52			
31	9-40-0	"	8.50			
32	9-41-0	"	8.50			
33	9-42-0	"	8.50		7.00	20.90

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 13,1925

Orifice used # 46
Temp. water 76°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Manometer Reading Right	Manometer Reading Diff.	Water column inches	Weight water and can lbs. Fairbanks 28x36268
		feet of water column				
34	9-43-0	0.32	8.51			
35	9-44-0	"	8.53			
36	9-45-0	"	8.52			
37	9-46-0	"	8.47			
38	9-47-0	"	8.54			
39	9-48-0	"	8.55			
40	9-49-0	"	8.54			
41	9-50-0	0.32	8.53		7.00	35.70
		Av. 0.32	8.51	8.19	7.00	31.52
		inches of mercury The Meriam Company Cleveland, Ohio				
				Total		
42	10-15-0	5.25	5.20	10.45	6.5	21.3
43	10-16-0	5.23	5.18	10.41		
44	10-17-0	5.25	5.20	10.45		
45	10-18-0	5.25	5.20	10.45		
46	10-19-0	5.25	5.20	10.45		
47	10-20-0	5.25	5.20	10.45		
48	10-21-0	5.26	5.21	10.47		
49	10-22-0	5.25	5.20	10.45		
50	10-23-0	5.23	5.18	10.41	6.5	39.90
51	10-24-0	5.23	5.18	10.41		
52	10-25-0	5.23	5.18	10.41		
53	10-26-0	5.25	5.20	10.45		
54	10-27-0	5.25	5.20	10.45		
55	10-28-0	5.33	5.28	10.61		
56	10-29-0	5.35	5.30	10.65		
57	10-30-0	5.31	5.26	10.57		
58	10-31-0	5.27	5.22	10.49	6.50	58.75
59	11-58-0	8.78	8.63	17.41	6.80	21.20
60	11-59-0	8.75	8.60	17.35		
61	12- 0-0	8.67	8.52	17.19		
62	12-01-0	8.63	8.48	17.11		
63	12-02-0	8.65	8.50	17.15		
64	12-03-0	8.61	8.46	17.07		
65	12-04-0	8.57	8.42	16.99		
66	12-05-0	8.57	8.42	16.99		
67	12-06-0	8.60	8.45	17.05	6.80	44.80
68	12-07-0	8.60	8.45	17.05		
69	12-08-0	8.57	8.42	16.99		
70	12-09-0	8.55	8.40	16.95		
71	12-10-0	8.55	8.40	16.95		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 13, 1925

Orifice used # 46
Temp. water 76°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Total inches of mercury The Meriam Company Cleveland, Ohio	Water column inches	Weight water and can lbs. Fairbanks 38x36268
72	12-11-0	8.55	8.40	16.95		
73	12-12-0	8.57	8.42	16.99		
74	12-13-0	8.60	8.45	17.05		
75	12-14-0	8.60	8.45	17.05	6.80	68.45
76	12-22-0	13.63	13.18	26.81	7.10	21.25
77	12-23-0	13.60	13.15	26.75		
78	12-24-0	13.60	13.15	26.75		
79	12-25-0	13.61	13.16	26.77		
80	12-26-0	13.61	13.16	26.77		
81	12-27-0	13.60	13.15	26.75		
82	12-28-0	13.75	13.30	27.05		
83	12-29-0	13.75	13.30	27.05		
84	12-30-0	13.65	13.20	26.85		
85	12-31-0	13.60	13.15	26.75		
86	12-32-0	13.60	13.15	26.75		
87	12-33-0	13.61	13.16	26.77		
88	12-34-0	13.61	13.16	26.77		
89	12-35-0	13.60	13.15	26.75		
90	12-36-0	13.60	13.15	26.75		
91	12-37-0	13.60	13.15	26.75		
92	12-38-0	13.60	13.15	26.75	7.10	79.85

August 14, 1925

Orifice used # 43
Temp. water 77°F

1	11-10-0	13.68	13.20	26.88	7.80	21.30
2	11-11-0	13.64	13.16	26.80		
3	11-12-0	13.66	13.18	26.84		
4	11-13-0	13.68	13.20	26.88		
5	11-14-0	13.69	13.21	26.90		
6	11-15-0	13.72	13.24	26.96		
7	11-16-0	13.68	13.20	26.88	8.30	47.50
8	11-17-0	13.68	13.20	26.88		
9	11-18-0	13.68	13.20	26.88		
10	11-19-0	13.58	13.10	26.68		
11	11-20-0	13.58	13.10	26.68		
12	11-21-0	13.58	13.10	26.68		
13	11-22-0	13.63	13.15	26.78	8.50	74.20
14	11-30-0	8.62	8.42	17.04	7.40	21.30
15	11-31-0	8.62	8.42	17.04		
16	11-32-0	8.60	8.40	17.00		
17	11-33-0	8.60	8.40	17.00		
18	11-34-0	8.62	8.42	17.04		
19	11-35-0	8.74	8.54	17.28		
20	11-36-0	8.78	8.58	17.36	7.55	42.50
21	11-37-0	8.75	8.55	17.30		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Orifice used # 43
Temp. water 77°F

Howell, R. S.
August 14, 1925

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading The Meriam Company Cleveland, Ohio: Left	Right	Total inches of mercury	Water column inches	Weight water and can lbs. Fairbanks 28x36268
22	11-38-0	8.72	8.52	17.24		
23	11-39-0	8.65	8.45	17.10		
24	11-40-0	8.64	8.44	17.08		
25	11-41-0	8.60	8.40	17.00		
26	11-42-0	8.62	8.42	17.04	7.55	63.90
27	11-50-0	4.64	4.58	9.22	7.30	21.30
28	11-51-0	4.61	4.55	9.16		
29	11-52-0	4.58	4.52	9.10		
30	11-53-0	4.57	4.51	9.08		
31	11-54-0	4.56	4.50	9.06		
32	11-55-0	4.56	4.50	9.06		
33	11-56-0	4.58	4.52	9.10		
34	11-57-0	4.61	4.55	9.16		
35	11-58-0	4.61	4.55	9.16		
36	11-59-0	4.61	4.55	9.16		
37	12- 0-0	4.58	4.52	9.10	7.30	47.5
38	12-01-0	4.58	4.52	9.10		
39	12-02-0	4.60	4.54	9.14		
40	12-03-0	4.58	4.52	9.10		
41	12-04-0	4.58	4.52	9.10		
42	12-05-0	4.58	4.52	9.10		
43	12-06-0	4.57	4.51	9.08		
44	12-07-0	4.57	4.51	9.08		
45	12-08-0	4.56	4.50	9.06		
46	12-09-0	4.56	4.50	9.06		
47	12-10-0	4.56	4.50	9.06	7.30	73.85
		feet of water column of water		Diff.		
48	12-44-0	0.32	8.62	8.30	8.50	21.3
49	12-45-0	0.32	8.61	8.29		
50	12-46-0	0.32	8.58	8.26		
51	12-47-0	0.32	8.64	8.32		
52	12-48-0	0.32	8.66	8.34		
53	12-49-0	0.32	8.64	8.32		
54	12-50-0	0.32	8.63	8.31		
55	12-51-0	0.32	8.61	8.29		
56	12-52-0	0.32	8.58	8.26		
57	12-53-0	0.32	8.57	8.25		
58	12-54-0	0.32	8.55	8.23	8.55	45.3
59	12-55-0	0.32	8.58	8.26		
60	12-56-0	0.32	8.62	8.30		
61	12-57-0	0.32	8.62	8.30		
62	12-58-0	0.32	8.60	8.28		
63	12-59-0	0.32	8.58	8.26		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 14, 1925

Orifice #43
Temp. water 77°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Diff. feet of water column of water	Water column inches	Weight water and can lbs. Fairbanks 28x36268
64	1- 0-0	0.32:	8.56	8.24:		
65	1-01-0	0.32:	8.54	8.22:		
66	1-02-0	0.32:	8.58	8.26:		
67	1-03-0	0.32:	8.58	8.26:		
68	1-04-0	0.32:	8.57	8.25:	8.55	69.10
69	1-24-0	0.35:	4.50	4.15:	7.90	21.30
70	1-26-0	0.35:	4.50	4.15:		
71	1-28-0	0.35:	4.50	4.15:		
72	1-30-0	0.35:	4.50	4.15:		
73	1-32-0	0.35:	4.50	4.15:		
74	1-34-0	0.35:	4.50	4.15:		
75	1-36-0	0.35:	4.50	4.15:	7.90	42.20
76	1-38-0	0.35:	4.50	4.15:		
77	1-40-0	0.35:	4.50	4.15:		
78	1-42-0	0.35:	4.50	4.15:		
79	1-44-0	0.35:	4.50	4.15:		
80	1-46-0	0.35:	4.50	4.15:		
81	1-48-0	0.35:	4.50	4.15:	7.90	63.00
82	1-56-0	0.36:	2.25	1.89:	7.75	21.30
83	1-58-0	0.36:	2.25	1.89:		
84	2- 0-0	0.36:	2.25	1.89:		
85	2-02-0	0.36:	2.25	1.89:		
86	2-04-0	0.36:	2.25	1.89:		
87	2-06-0	0.36:	2.25	1.89:		
88	2-08-0	0.36:	2.25	1.89:		
89	2-10-0	0.36:	2.25	1.89:		
90	2-11-0	0.36:	2.25	1.89:	7.75	39.60
91	2-12-0	0.36:	2.25	1.89:		
92	2-14-0	0.36:	2.25	1.89:		
93	2-16-0	0.36:	2.25	1.89:		
94	2-18-0	0.36:	2.25	1.89:		
95	2-20-0	0.36:	2.25	1.89:		
96	2-22-0	0.36:	2.25	1.89:		
97	2-24-0	0.36:	2.25	1.89:		
98	2-36-0	0.36:	2.25	1.89:	7.50	57.30

August 14, 1925

Orifice used # 39
Temp. water 77°F

99	2-44-0	0.36:	2.20	1.84:	6.35	21.30
100	2-46-0	0.36:	2.20	1.84:		
101	2-48-0	0.36:	2.20	1.84:		
102	2-50-0	0.36:	2.20	1.84:		
103	2-52-0	0.36:	2.20	1.84:		
104	2-54-0	0.36:	2.20	1.84:		

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 14, 1925

Orifice used # 39
Temp. water 77°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Diff. feet of water water column	Water column inches	Weight water and can lbs. Fairbanks 28x36268
105	2-56-0	0.36	2.20	1.84		
106	2-58-0	0.36	2.20	1.84		
107	2-59-0	0.36	2.20	1.84	6.35	42.50
108	3- 0-0	0.36	2.20	1.84		
109	3-02-0	0.36	2.20	1.84		
110	3-04-0	0.36	2.20	1.84		
111	3-06-0	0;36	2.20	1.84		
112	3-08-0	0.36	2.20	1.84		
113	3-10-0	0.36	2.20	1.84		
114	3-12-0	0;36	2.20	1.84		
115	3-14-0	0.36	2.20	1.84	6.35	63.70
116	3-22-0	0.35	4.25	3.90	6.60	21.30
117	3-24-0	0.35	4.25	3.90		
118	3-26-0	0.35	4.25	3.90		
119	3-28-0	0.35	4.25	3.90		
120	3-30-0	0.35	4.25	3.90		
121	3-32-0	0.35	4.25	3.90		
122	3-34-0	0.35	4.25	3.90	6.60	45.80
123	3-36-0	0.35	4.25	3.90		
124	3-38-0	0.35	4.25	3.90		
125	3-40-0	0.35	4.25	3.90		
126	3-42-0	0.35	4.25	3.90		
127	3-44-0	0.35	4.25	3.90		
128	3-46-0	0.35	4.25	3.90	6.60	70.65
129	3-54-0	0.32	8.25	7.93	7.20	21.30
130	3-55-0	0.32	8.25	7.93		
131	3-56-0	0.32	8.25	7.93		
132	3-57-0	0.32	8.25	7.93		
133	3-58-0	0.32	8.25	7.93		
134	3-59-0	0.32	8.25	7.93		
135	4- 0-0	0.32	8.25	7.93		
136	4-01-0	0.32	8.25	7.93		
137	4-02-0	0.32	8.25	7.93		
138	4-03-0	0.32	8.25	7.93		
139	4-04-0	0.32	8.25	7.93	7.20	50.00
140	4-05-0	0.32	8.25	7.93		
141	4-06-0	0.32	8.25	7.93		
142	4-07-0	0.32	8.25	7.93		
143	4-08-0	0.32	8.25	7.93		
144	4-09-0	0.32	8.25	7.93		
145	4-10-0	0.32	8.25	7.93		
146	4-11-0	0.32	8.25	7.93		
147	4-12-0	0.32	8.25	7.93		
148	4-13-0	0.32	8.25	7.93		
149	4-14-0	0.32	8.25	7.93	7.20	78.90

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 14, 1925

Orifice used # 39
Temp. water 77°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading inches of mercury The Meriam Company Cleveland, Ohio Left	Right	Total	Water column inches	Weight water and can lbs. Fairbanks 28x36268
150	4-24-0	4.90	4.90	9.80	7.3	21.30
151	4-25-0	4.90	4.90	9.80		
152	4-26-0	4.90	4.90	9.80		
153	4-27-0	4.90	4.90	9.80		
154	4-28-0	4.90	4.90	9.80		
155	4-29-0	4.90	4.90	9.80		
156	4-30-0	4.90	4.90	9.80		
157	4-31-0	4.90	4.90	9.80		
158	4-32-0	4.90	4.90	9.80	7.30	48.20
159	4-34-0	4.90	4.90	9.80		
160	4-35-0	4.90	4.90	9.80		
161	4-36-0	4.90	4.90	9.80		
162	4-37-0	4.90	4.90	9.80		
163	4-38-0	4.90	4.90	9.80		
164	4-39-0	4.90	4.90	9.80		
165	4-40-0	4.90	4.90	9.80		
166	4-50-0	4.90	4.90	9.80	7.30	75.30
					August 15, 1925	
1	7-48-0	8.50	8.40	16.90	6.30	21.20
2	7-49-0	8.50	8.40	16.90		
3	7-50-0	8.50	8.40	16.90		
4	7-51-0	8.50	8.40	16.90		
5	7-52-0	8.50	8.40	16.90		
6	7-53-0	8.50	8.40	16.90		
7	7-54-0	8.50	8.40	16.90		
8	7-55-0	8.50	8.40	16.90		
9	7-56-0	8.50	8.40	16.90		
10	7-57-0	8.50	8.40	16.90		
11	7-58-0	8.50	8.40	16.90		
12	7-59-0	8.50	8.40	16.90		
13	8-0-0	8.50	8.40	16.90	6.30	73.30
14	8-07-0	13.60	13.20	26.80	6.60	21.30
15	8-08-0	"	"	"		
16	8-09-0	"	"	"		
17	8-10-0	"	"	"		
18	8-11-0	"	"	"		
19	8-12-0	"	"	"		
20	8-13-0	"	"	"		
21	8-14-0	"	"	"		
22	8-15-0	"	"	"		
23	8-16-0	"	"	"		
24	8-17-0	"	"	"		
25	8-18-0	"	"	"		
26	8-19-0	"	"	"		86.50
				26.80	6.60	65.20 Net

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 20, 1925

Orifice used # 80
Temp. water 81 °F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Right	Diff.	Water column inches	Quantity Discharged cu. ft. Measuring Bottle # 1
		feet of water column				
1	7-46-0	0.36	2.20	1.84	6.00	0
2	7-48-0	0.36	2.20	1.84		
3	7-50-0	0.36	2.20	1.84		
4	7-52-0	0.36	2.20	1.84		
5	7-54-0	0.36	2.20	1.84		
6	7-56-0	0.36	2.20	1.84	6.00	0.0070694
7	8- 0-0	0.36	2.20	1.84	6.00	0
8	8-10-0	0.36	2.20	1.84	6.00	0.0070694
		inches of mercury		Total		Measuring Bottle # 2
9	8-57-0	7.04	6.96	14.00	6.65	0
10	8-58-0	7.04	6.96	14.00		
11	8-59-0	"	"	"		
12	9- 0-0	"	"	"		
13	9-01-0	"	"	"		
14	9-02-0	"	"	"		
15	9-03-0	"	"	"		
16	9-04-0	"	"	"		
17	9-05-0	"	"	"		
18	9-06-0	"	"	"		
19	9-07-0	"	"	"		
20	9-08-0	"	"	"		
21	9-09-0	"	"	"		
22	9-10-0	"	"	"		
23	9-11-0	"	"	"		
24	9-12-0	"	"	"		
25	9-13-0	"	"	"		
26	9-14-0	7.04	6.96	14.00	6.65	0.039203
Orifice # 76						
27	9-51-0	8.00	7.90	15.90	6.70	0
37	10-01-54	8.00	7.90	15.90	6.70	0.039203
38	10-30-0	14.20	13.75	27.95	7.10	0
46	10-28-30	14.20	13.75	27.95	7.10	0.039203
47	10-41-0	5.05	5.00	10.05	6.50	0
60	10-54-0	5.05	5.00	10.05	6.50	0.039203
		Head #/□"				
		Crosby 686317				
61	11-20-0	34			7.7	0
66	11-25-35	34			7.7	9

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 30, 1925

Orifice used # 80
Temp. water 81°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading Left	Manometer Reading Right	Manometer Reading Diff. feet of water water column	Water column inches	Quanity discharged cu. ft. Measuring Bottle # 3
		Head #/□" Crosby 818446				
67	12-0-0	104.5			8.35	0
68	12-01-0	104.8				
69	12-02-0	104.6				
70	12-03-0	105.0				
71	12-04-0	105.0				
72	12-05-0	104.8				
73	12-06-0	104.5				
74	12-06-30	104.5			8.40	0.76317
75	12-23-0	66.8			8.30	0
76	12-24-0	66.6				
77	12-25-0	66.8				
78	12-26-0	66.6				
79	12-27-0	66.5				
80	12-28-0	66.7				
81	12-29-0	66.4				
82	12-30-0	66.5				
83	12-30-47	66.5			8.35	0.76317
Orifice used # 55		inches of mercury				
84	4-10-0	0.31	8.55	8.24	6.70	0
89	4-15-37.9	0.31	8.55	8.24	6.70	0.76317

August 24, 1925

Orifice used # 39
Temp. water 72°F

1	8-0-0	0.35	2.20		7.3	0
2	8-01-0	0.35	2.22			
3	8-02-0	0.35	2.21			
4	8-03-0	0.35	2.20			
		Av.				
			2.207	1.857	7.3	0.76317
5	8-10-0	0.34	4.35	4.01	7.2	0
7	8-12-06.4	0.34	4.35	4.01	7.2	0.76317
8	8-30-0	0.31	8.50	8.19	7.7	21.25
18	8-40-0	0.31	8.50	8.19	7.7	50.45
19	8-50-0		2.05		7.7	
22	8-53-15.8		2.05		7.7	
Orifice used # 43						Bottle # 3
23	9-0-0	0.35	2.20	1.85	7.5	0
26	9-03-0	0.35	2.20	1.85		0.76317
27	9-30-0	0.34	4.05	3.71	7.75	0
29	9-32-52	0.34	4.05	3.71	7.75	0.76317

DETERMINATION OF THE COEFFICIENT OF DISCHARGE OF SMALL ORIFICES

Howell, R. S.
August 24, 1925.

Orifice used # 39
Temp. water 72°F

Run #	Time hr-min-sec Stop watch # 5	Manometer Reading feet of water water column Left	Right	Diff.	Water column inches	Quantity discharged cu. ft Measuring Bottle # 3
30	9-40-0	0.31	7.52	7.21	8.25	
32	9-42-7.2	0.31	7.52	7.21	8.25	
33	10-10-0	0.35	2.35	2.00	7.3	0
47	10-24-24	0.35	2.35	2.00	7.3	0.039203
48	10-30-0	0.31	7.55	7.24	8.00	0
55	10-37-55.4	0.31	7.55	7.24	8.10	0.039203

August 8, 1925

Orifice used # 55
Temp. water 74°F

L	Time	inches of mercury: The Meriam Company, Cleveland, Ohio			Weight water and can - lbs. Fairbanks 28x36268	
				Total		
1	11-30-0	13.80	13.32	27.12	7.30	21.25
2	11-31-0	13.84	13.36	27.20		
3	11-32-0	13.84	13.36	27.20		
4	11-33-0	13.83	13.35	27.18		
5	11-34-0	13.83	13.35	27.18		
6	11-35-0	13.83	13.35	27.18		
7	11-36-0	13.83	13.35	27.18		
8	11-37-0	13.82	13.34	27.16		
9	11-38-0	13.85	13.37	27.22		
10	11-39-0	13.84	13.36	27.20		
11	11-40-0	13.79	13.31	27.10		
12	11-41-0	13.84	13.36	27.20		
13	11-42-0	13.88	13.40	27.28		
14	11-43-0	13.88	13.40	27.28		
15	11-44-0	13.86	13.38	27.24		
16	11-45-0	13.86	13.38	27.24	7.30	44.80
17	11-46-0	13.87	13.39	27.26		
18	11-47-0	13.86	13.38	27.24		
19	11-48-0	13.80	13.32	27.12		
20	11-49-0	13.78	13.30	27.08		
21	11-50-0	13.77	13.29	27.06		
22	11-51-0	13.78	13.30	27.08		
23	11-52-0	13.78	13.30	27.08		
24	11-53-0	13.77	13.29	27.06		
25	11-54-0	13.80	13.32	27.12		
26	11-55-0	13.83	13.35	27.18		
27	11-56-0	13.85	13.37	27.22		
28	11-57-0	13.80	13.32	27.12		
29	11-58-0	13.79	13.31	27.10		
30	11-59-0	13.78	13.30	27.08		
31	12- 0-0	13.77	13.29	27.06		68.15

DETERMINATION OF THE LENGTH OF THE SMOOTH SECTION OF JETS FROM SMALL ORIFICES

Howell, R. S.

Orifice used - Drill # 80

Run #	Manometer Reading Left	Manometer Reading Right	Diff.	Head #/□" Crosby 818446	Water column inches	Length Smooth Section inches
	feet H_2O					
1	0.35	2.02			7.1	1.00
2	0.34	4.30			7.3	1.60
3	0.31	8.50			8.0	2.10
	inches mercury					
4	5.00	5.00			7.7	2.10
5	8.20	8.00			7.8	2.20
6	13.90	13.50			7.9	2.50
7				19.	7.70	2.50
8				30	8.00	3.20
9				40	8.20	4.00
10				50	8.30	4.50
11				60	8.35	4.00
12				70	8.40	4.00
13				80	8.50	4.50
Orifice used # 76						
14	0.35	2.35			7.2	1.50
15	0.34	4.34			7.5	2.00
16	0.31	8.60			8.2	2.10
	inches mercury		total			
17	6	5.80	11.80		8.25	2.20
18	9	8.80	17.80		8.30	2.00
19	14.00	13.50	27.50		8.5	3.50
20				20	8.6	4.00
21				30	8.65	5.50
22				40	8.70	7.50
23				50	8.75	10.50
24				60	8.80	12.50
25				70	9.50	13.50
26				80	8.8	14.00
27				90	8.65	15.00
28				100	8.7	15.50
29	0.35	2.35			7.5	1.4
30	0.34	4.34			7.7	1.9
31	0.31	8.31			8.5	2.5
32				4	7.0	2.8
33				5	7.1	3.1
34				7	7.2	4.0
35				10	7.3	5.0
36				15	7.6	9.5
37				25	7.8	12.5
38				35	8.1	14.0
39				45	8.2	15.0
40				55	8.3	16.5
41				65	8.35	17.0
42				71	8.40	17.7

DETERMINATION OF THE LENGTH OF THE SMOOTH SECTION OF JETS FROM SMALL ORIFICES

Howell, R. S.

Orifice used # 60

Run #	Manometer Reading Left	Manometer Reading Right	Manometer Reading Diff.	Head #/□" Crosby 818446	Water column inches	Length Smooth Section inches
	feet H_2O					
43	0.35	2.35			7.2	2.5
44	0.34	4.34			7.5	2.8
45	0.31	8.31			8.0	4.5
46				4	8.1	6.5
47				6	8.2	8.5
48				9	8.25	11.5
49				13	8.3	15.5
50				19	8.4	18.5
51				25	8.5	19.0
52				33	8.6	19.5
53				43	8.7	22.0
54				52.5	8.75	23.0
55				65	8.80	23.0
56				80	8.50	23.5
57				105	11.50	22

August 25, 1925

Orifice used # 55

	feet of water		Total			
1	0.35	2.25			6.50	2.5
2	0.34	4.34			6.80	3.7
3	0.31	8.31			7.30	5.7
4				5	7.50	12.50
5				9	7.7	18.50
6				15	7.9	21.50
7				23	8.0	24.00
8				34	8.3	28.50
9				45	8.35	30.50
10				60	8.50	28.50
11				80	8.60	24.00
Orifice # 53						
12	0.35	2.35			6.9	2.50
13	0.34	4.34			7.2	3.00
14	0.31	8.31			7.7	6.5
15				5	7.8	11.50
16				7	7.9	16.50
17				11	8.1	22.50
18				16	8.3	23.50
19				26	8.4	25.50
20				40	8.5	23.00
21				60	8.7	22.00
22				80	8.75	17.50
23				105	8.85	15.00
Orifice used # 50						
24	0.35	2.35			7.40	3.0
25	0.34	4.34			7.70	5.5
26	0.31	8.31			8.20	10.5

DETERMINATION OF THE LENGTH OF THE SMOOTH SECTION OF JETS FROM SMALL ORIFICES

Howell, R. S.

August 25, 1925
Orifice used # 50

Run #	Manometer Reading: Left	Right	Total: feet of water	Head #/□" Crosby 818446	Water column inches	Length Smooth Section inches
27				5	8.35	16.5
28				8	8.40	22.5
29				12	8.50	28.5
30				17	8.60	29.5
31				23	8.70	30.5
32		5		35	8.80	25.5
33				50	8.90	24.0
34				70	11.00	23.5
35				82	11.00	19.0
Orifice used # 46						
36	0.35	2.35			6.7	5.5
37	0.34	4.34			6.9	14.5
38	0.31	8.31			7.5	18.5
39				5	7.6	21.5
40				8	7.7	26.5
41				12	7.9	29.5
42				17	8.0	34.5
43				23	8.1	35.5
44				35	8.3	37.0
45				50	8.5	31.5
46				70	8.6	24.5
47				85	8.7	20.5
48				105	8.8	16.5
Orifice used # .004						
49	0.35	2.35			5.6	
50	0.34	4.34			6.0	0.8
51	0.31	8.31			6.7	1.7
52				7	7.1	3.0
53				10	7.3	4.5
54				15	7.5	6.5
55				22	7.6	5.5
56				30	8.0	4.5
57				40	8.1	5.5
58				73	8.4	4.5

DETERMINATION OF THE DIAMETERS OF JETS FROM SMALL ORIFICES

Howell, R. S.

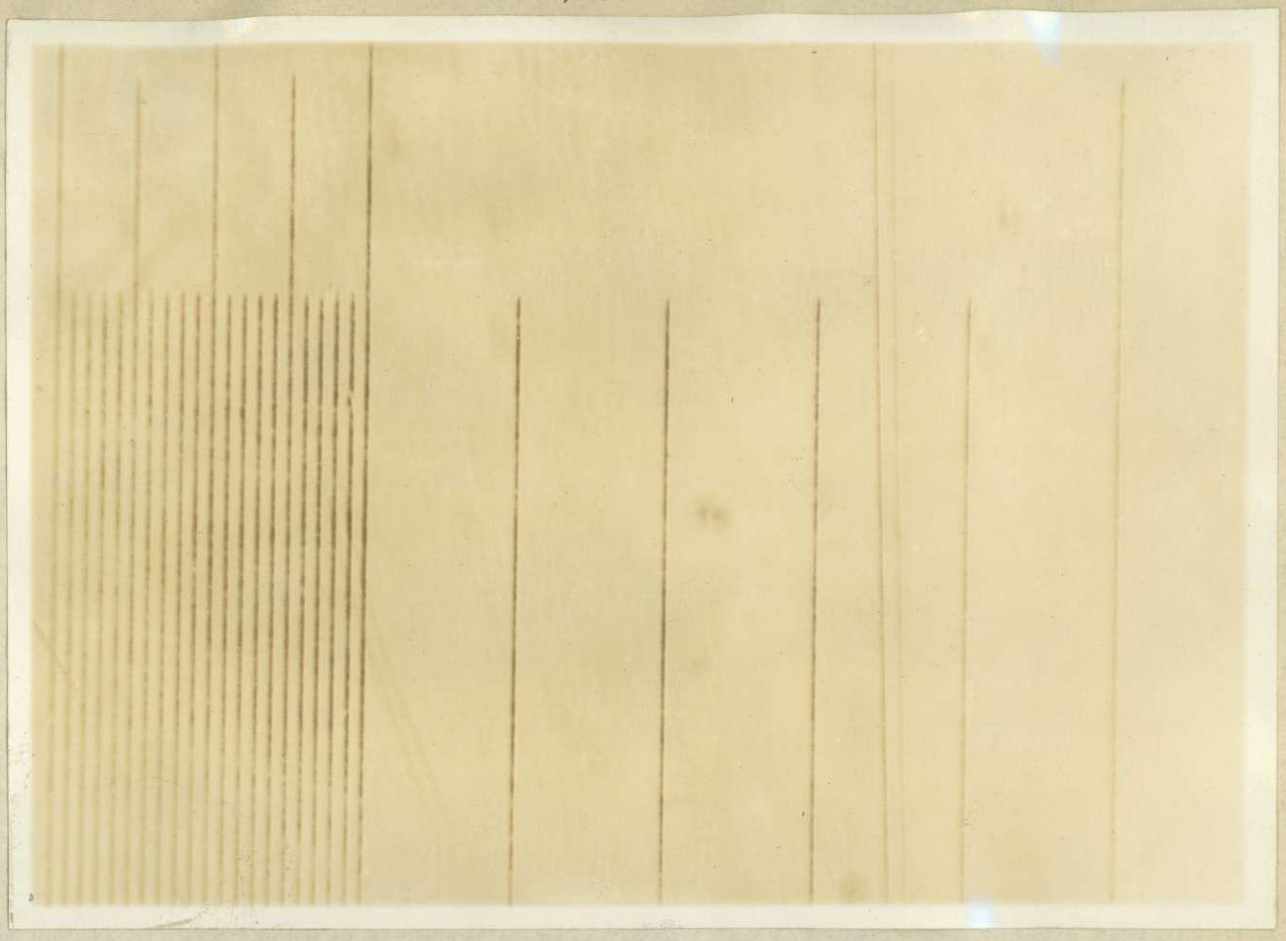
August 25,1925

Orifice used - Drill # 39

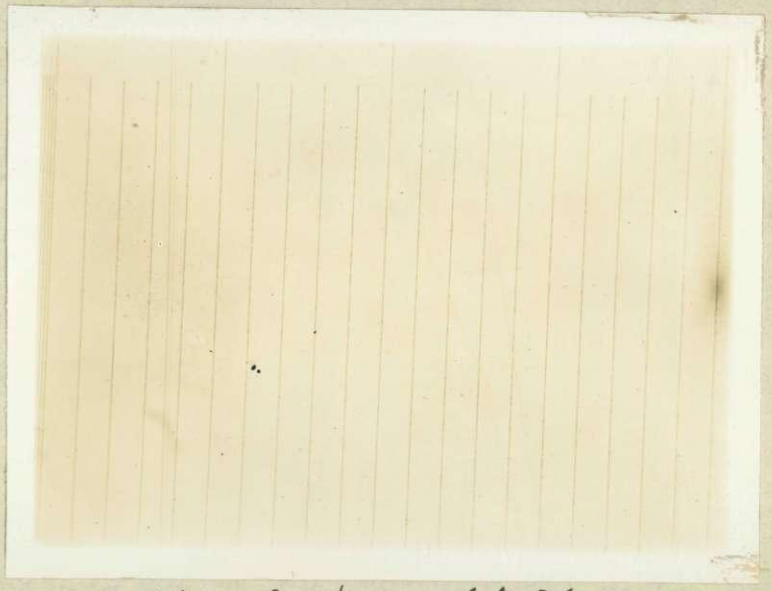
Reading #	Water column: inches	Manometer Left: feet water	Manometer Right: feet water	Diameter = Inches for Inches from orifice plate 0.70	1.20	1.70	2.20	2.70	3.20	Length Smooth Section-inches
1	7.30	0.35	2.35	.0906	.0910	.0812	.0911	.0880	.0878	
2	7.60	0.34	4.34	.0885	.0900	.0882	.0835	.0875	.0891	
3	8.20	0.31	8.31	.0887	.0884	.0885	.0879	.0877	.0885	
Mercury										
4	7.50	+ 5.1	- 5.0	.0880	.0850	.0830	.0835	.0820	.0845	
5	7.80	+10.18	-10.0	.0850	.0849	.0849	.0848	.0838	.0820	
6	8.00	+13.85	-13.5	.0821	.0822	.0822	.0820	.0830	.0820	
				3.70	4.20	4.70	5.20	4.30		
1	7.30	0.35	2.35	.0875						10
2	7.60	0.34	4.34	.0885	.0805	.0874	.0878			11
3	8.20	8.31	8.31	.0885	.0885	.0850	.0835			22
Mercury										
4	+ 7.50	+ 5.1	- 5.0	.0875	.0855	.0840	.0850			21
5	7.80	+10.18	-10.0	.0830	.0830	.0835	.0850	.0850		21
6	8.00	+13.85	-13.5	.0835	.0850	.0830	.0870	.0885		21

Orifice used # Drill # 43

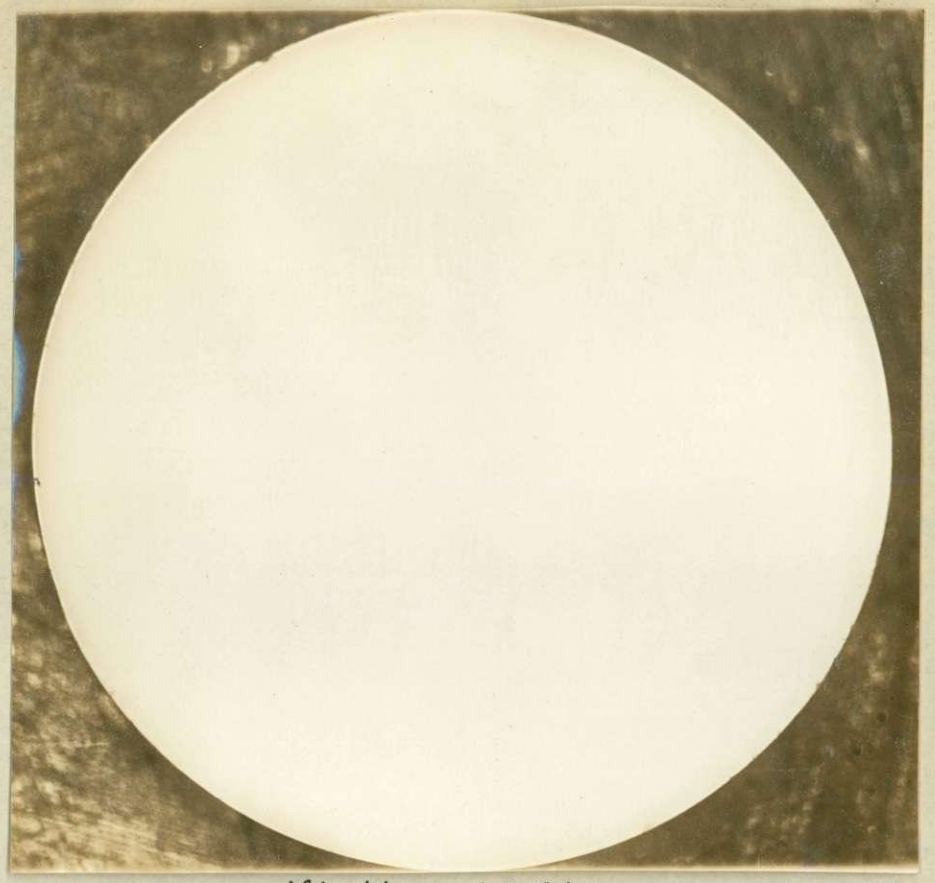
Reading #	Water column: inches	Manometer Left: feet water	Manometer Right: feet water	Diameter = Inches for Inches from orifice plate 0.70	1.20	1.70	2.20	2.70	3.20	Length Smooth Section-inches
1	7.30	0.35	2.35	.0740	.0793	.0790	.0810	.0770		
2	7.60	0.34	4.34	.0750	.0750	.0795	.0780	.0770	.0790	
3	8.10	0.31	8.31	.0745	.0725	.0710	.0750	.0790	.0770	
Mercury										
4	8.20	+ 5.1	- 5.0	.0790	.0760	.0710	.0725	.0770	.0785	
5	8	+10.18	-10.0	.0800	.0772	.0770	.0730	.0700	.0730	
6	8.50	+13.85	-13.5	.0820	.0830	.0800	.0877	.0700	.0710	
				3.70	4.20	4.70	5.20			
1	7.30	0.35	2.35	.0						12-1/2
2	7.60	0.34	4.34	.0820	.0730					16-1/2
3	8.10	0.31	8.31	.0730	.0735	.0740	.0770			18-1/2
Mercury										
4	8.20	+ 5.1	- 5.0	.0781	.0720	.0735	.0755			20
5	8	+10.18	-10.0	.0750	.0800	.0810	.0820			22
6	8.50	+13.85	-13.5	.0720	.0780	.0820	.0840			25



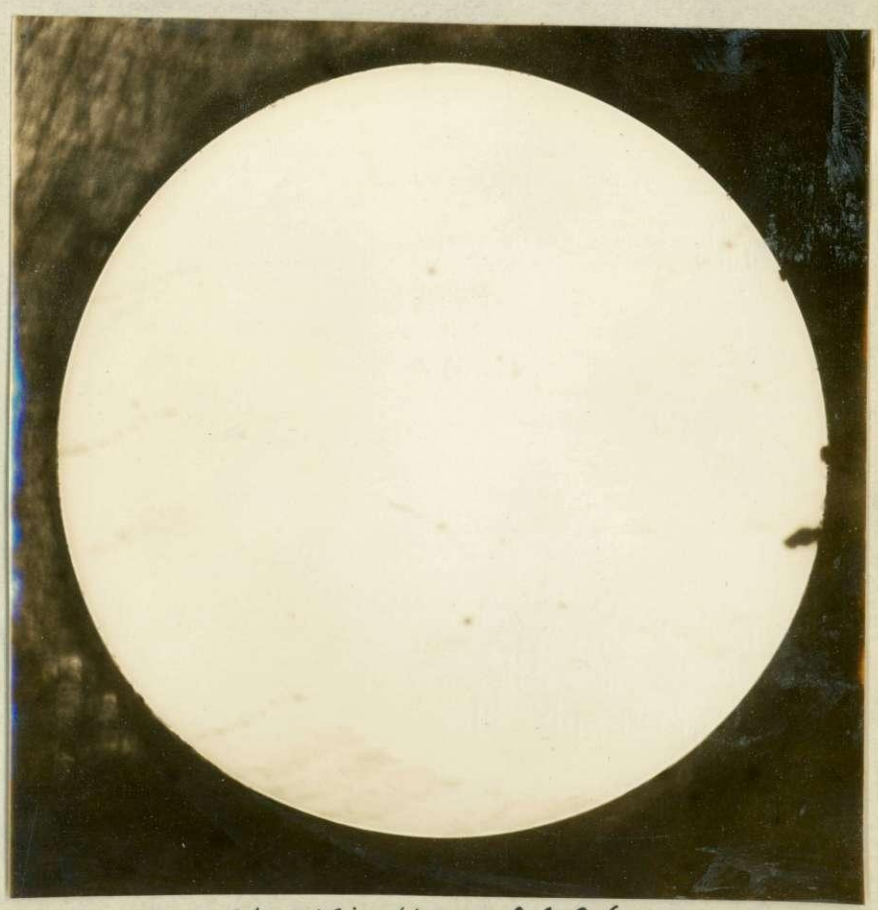
Magnification 200
Figure 4



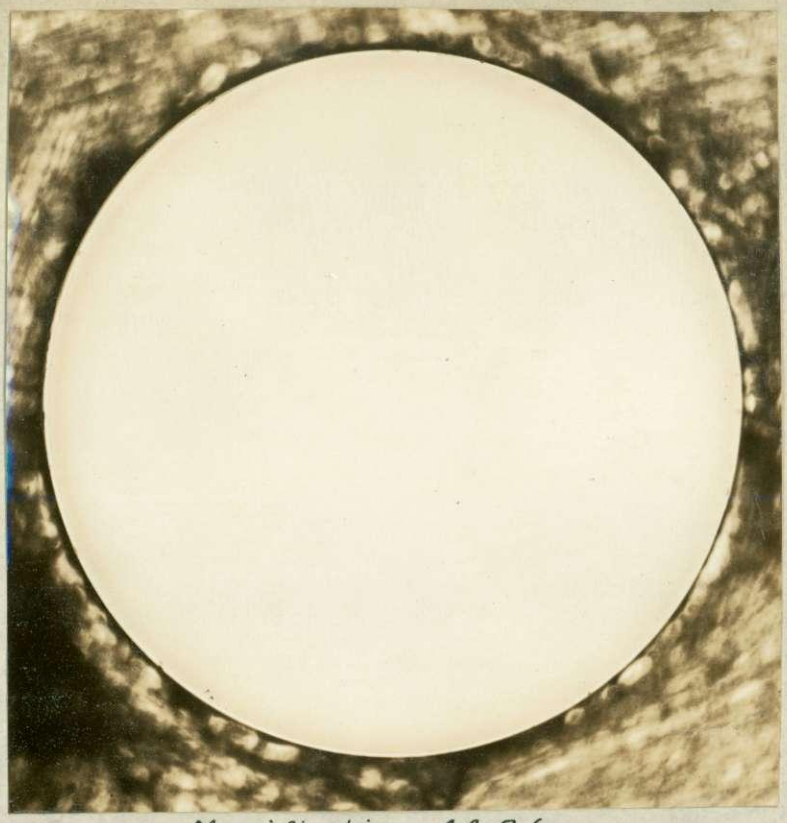
Magnification 44.26
Figure 5



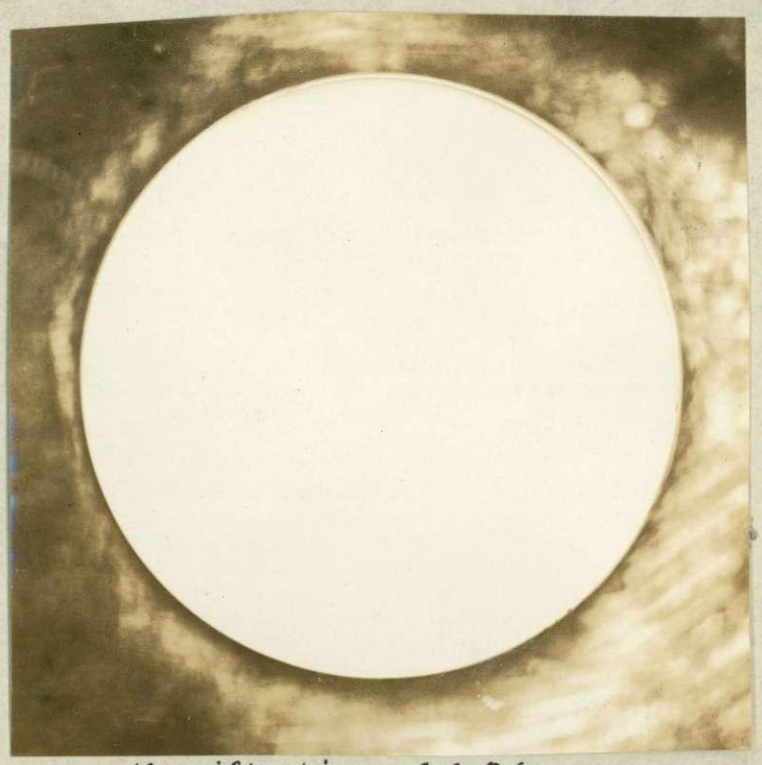
Magnification 44.26
Drill #39 – Orifice dia. 0.10030"
Figure 6



Magnification 44.26
Drill #43 Orifice dia. 0.09028"
Figure 7

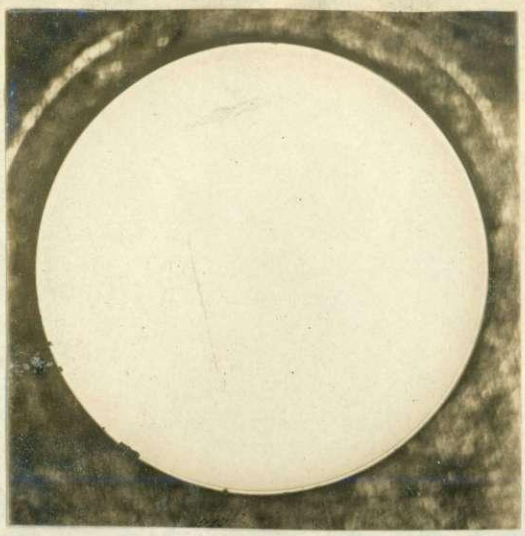


Magnification 44.26
Drill #46 – Orifice dia. 0.08180"
Figure 8



Magnification 44.26
Drill #50 - Orifice dia. 0.07004"
Figure 9

Figure 10 - Drill #53 - Plate broken



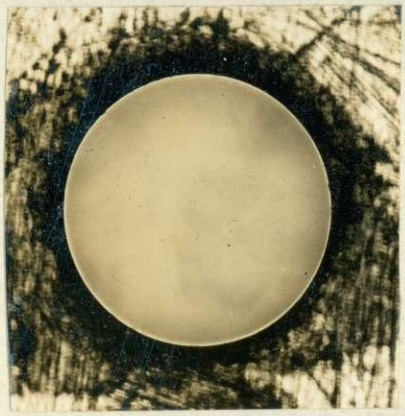
Magnification 44.26

Drill #55 - Orifice dia. 0.05220"

Figure 11

Drill #60 - Orifice dia. 0.04110"

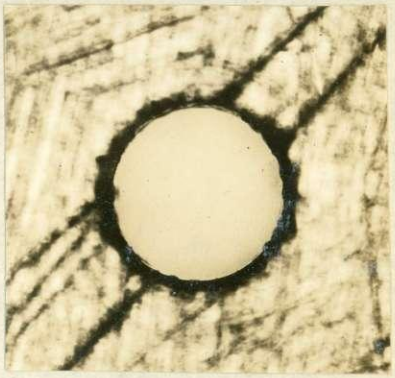
Figure 12



Magnification 44.26

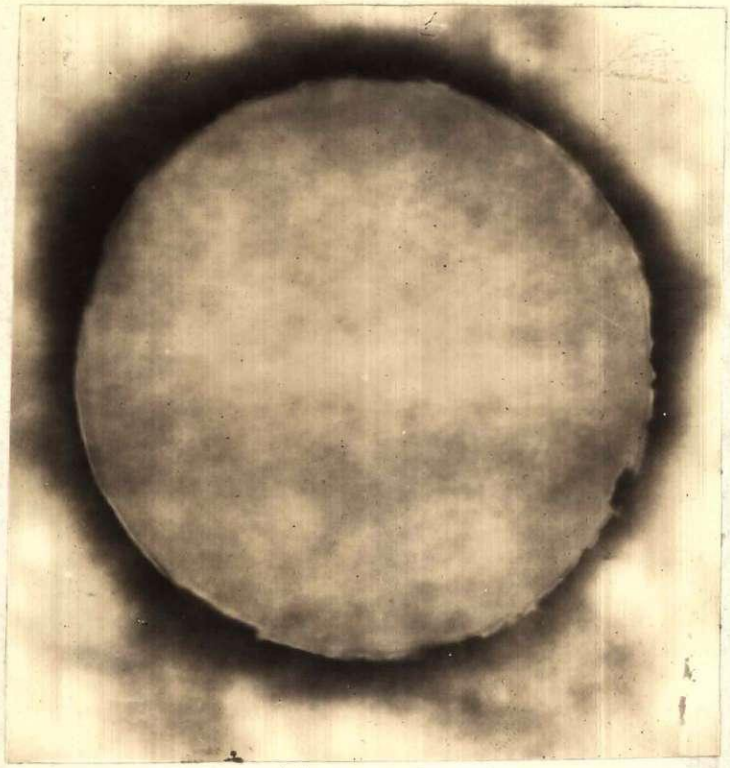
Drill #68 - Orifice dia. 0.03140"

Figure 13



Drill #76 - Orifice dia. 0.02005"

Figure 14

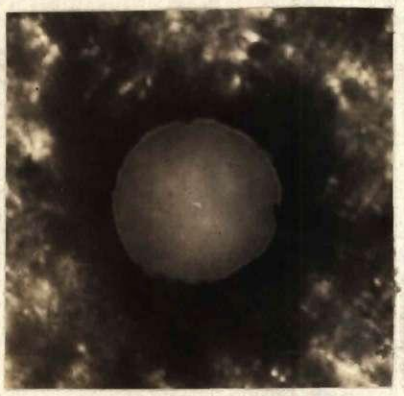


Magnification 200
Drill #80 - Orifice dia. 0.01485"

Figure 15

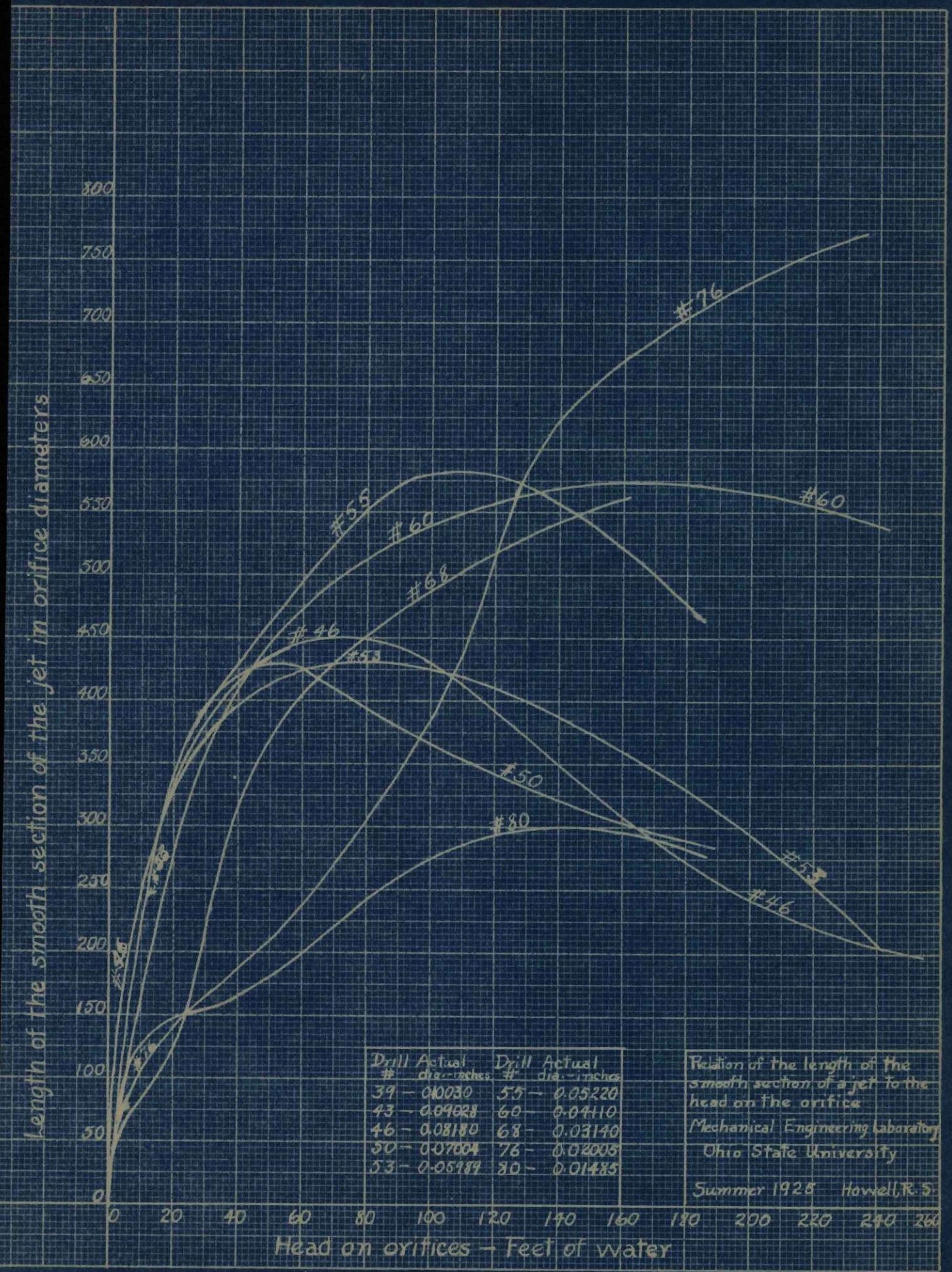
Magnification 44.26
Drill #80 - Orifice dia. 0.01485"

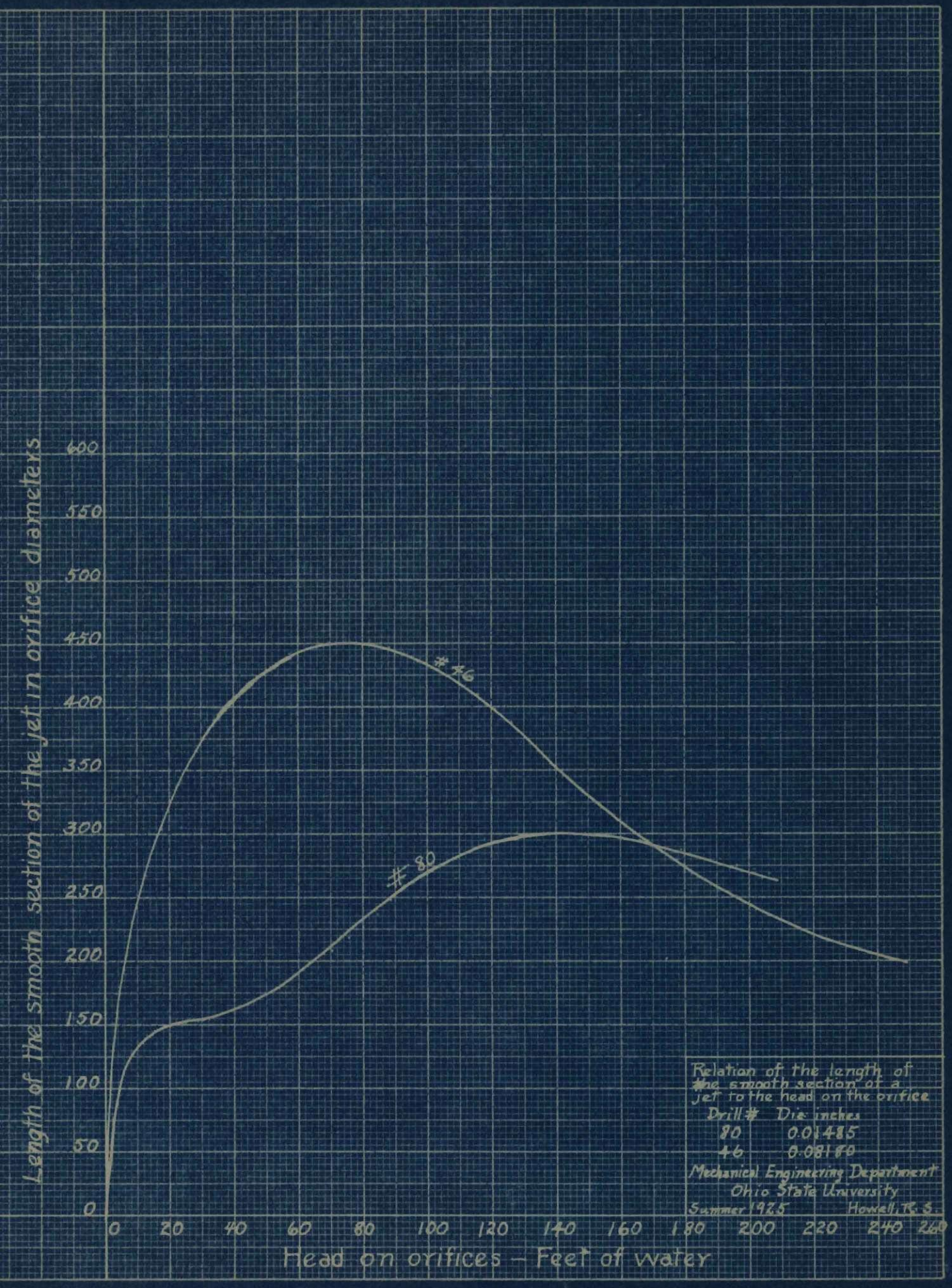
Figure 16

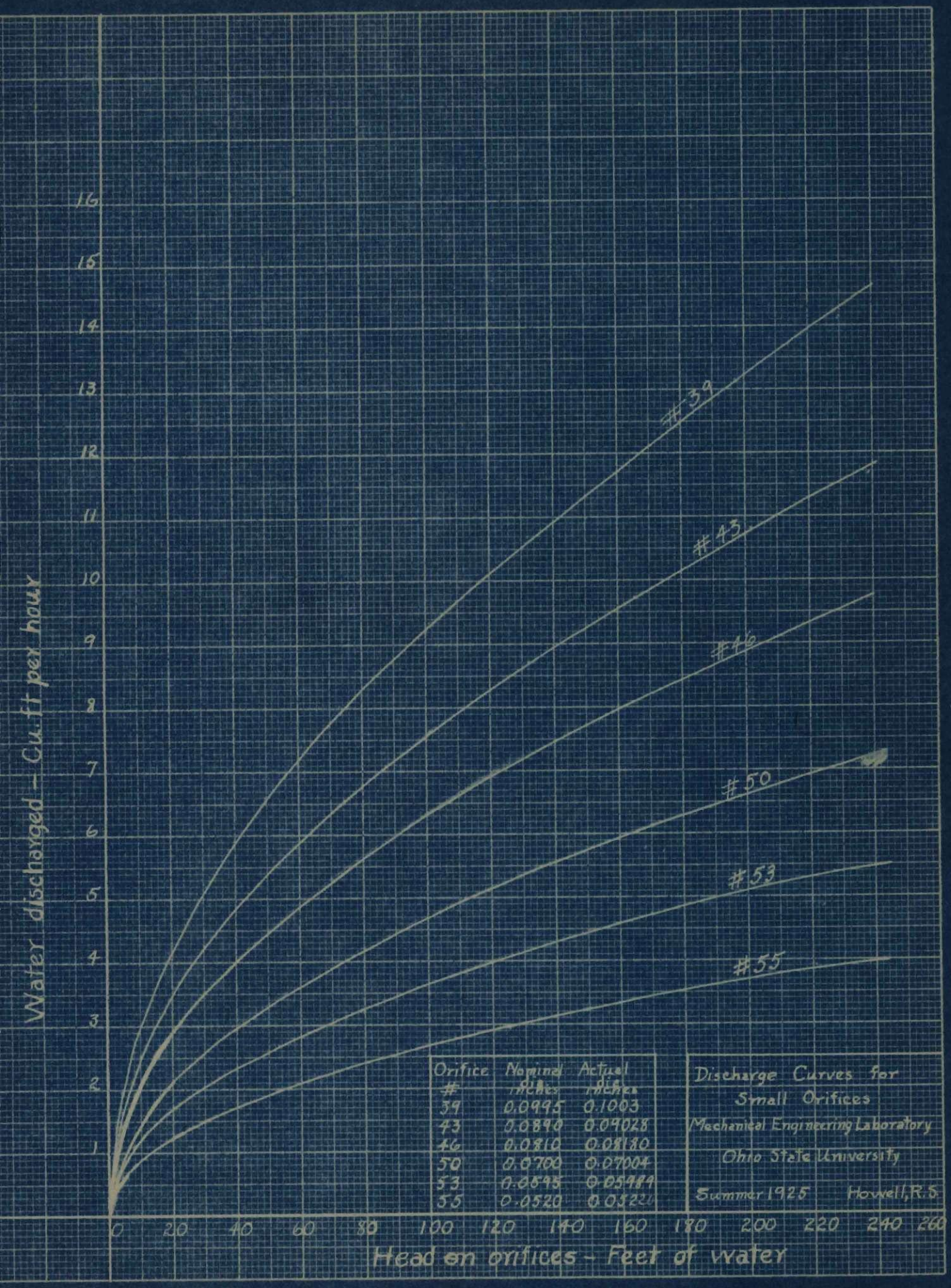


Magnification 200
Drill size 0.004"
Orifice dia. 0.00419"

Figure 17


Length of the smooth section of the jet in orifice diameters
Head on orifices – Feet of water
#76
#55
#60
#60
#68
#46
#53
#50
#80
#53
#46
Drill # Actual dia.-inches
39 – 0.10030
43 – 0.09628
46 – 0.08180
50 – 0.07004
53 – 0.05984
Drill # Actual dia.-inches
55 – 0.05220
60 – 0.04110
68 – 0.03140
76 – 0.02005
80 – 0.01485
Relation of the length of the smooth section of a jet to the head on the orifice
Mechanical Engineering Laboratory
Ohio State University
Summer 1928 Howell, R. S.


Length of the smooth section of the jet in orifice diameters
600
550
500
450
400
350
300
250
200
150
100
50
0
#46
#80
0 20 40 60 80 100 120 140 160 180 200 220 240 260
Head on orifices – Feet of water
Relation of the length of the smooth section of a jet to the head on the orifice
Drill # Dia. inches
80 0.01485
46 0.08160
Mechanical Engineering Department
Ohio State University
Summer 1925 Howell T. S.



Orifice #	Nominal Size Inches	Actual Inches
39	0.0995	0.1003
43	0.0890	0.09028
46	0.0810	0.08180
50	0.0700	0.07004
53	0.0595	0.05484
55	0.0520	0.05220

Discharge Curves for Small Orifices

Mechanical Engineering Laboratory

Ohio State University

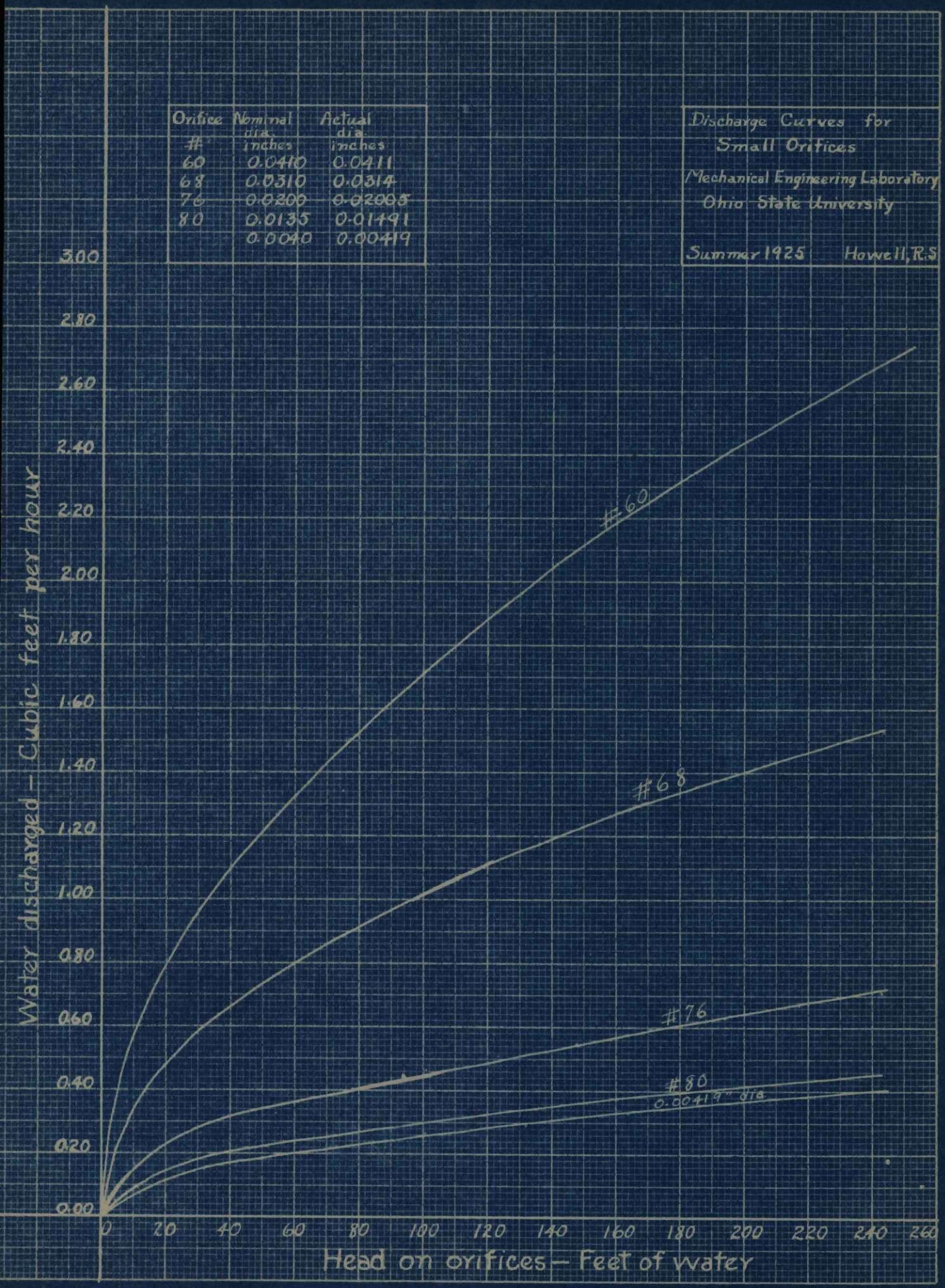
Summer 1925 Howell, R.S.

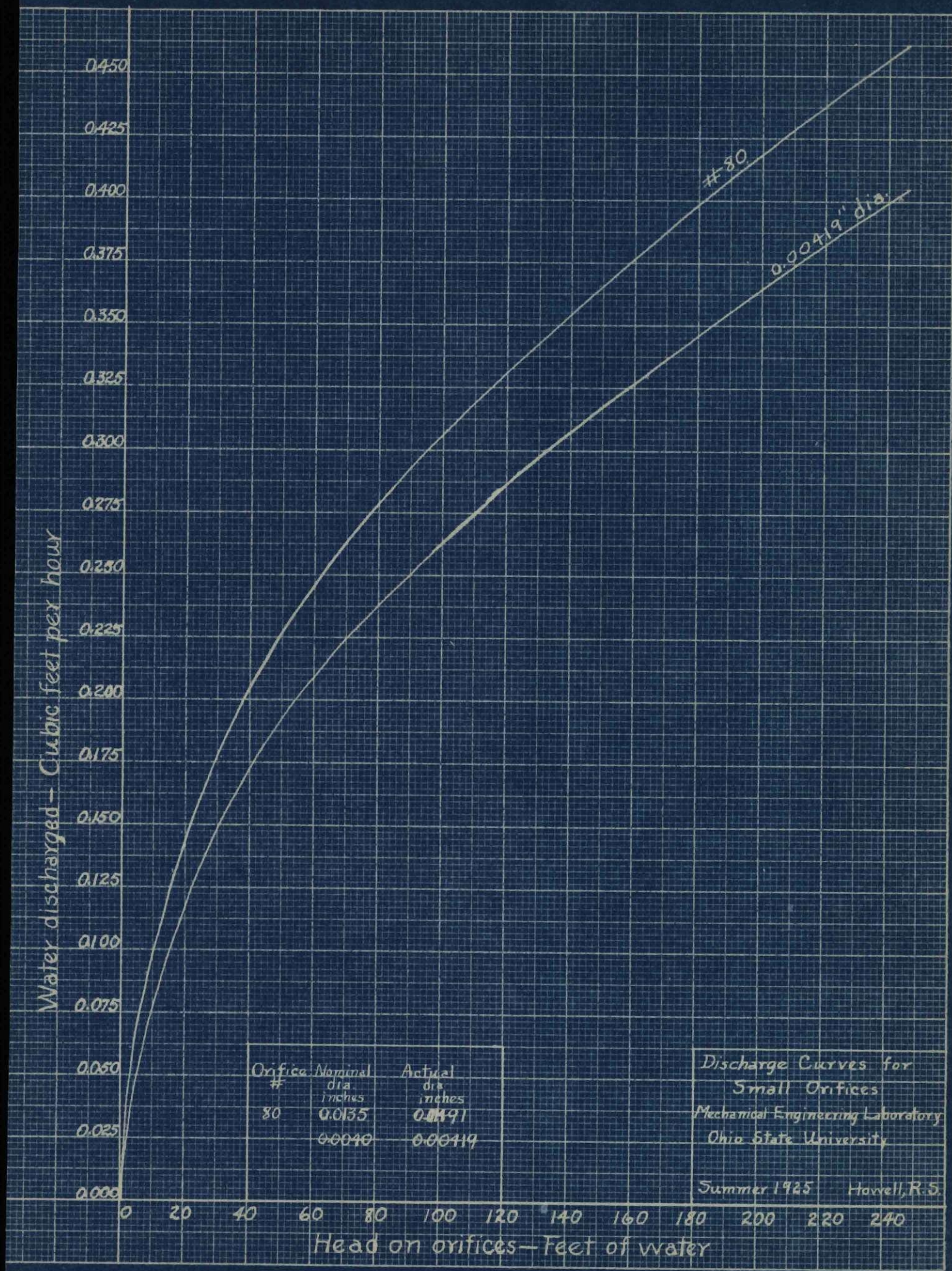
Orifice #	Nominal dia. inches	Actual dia. inches
60	0.0410	0.0411
68	0.0310	0.0314
76	0.0200	0.02008
80	0.0135	0.01491
	0.0040	0.00419

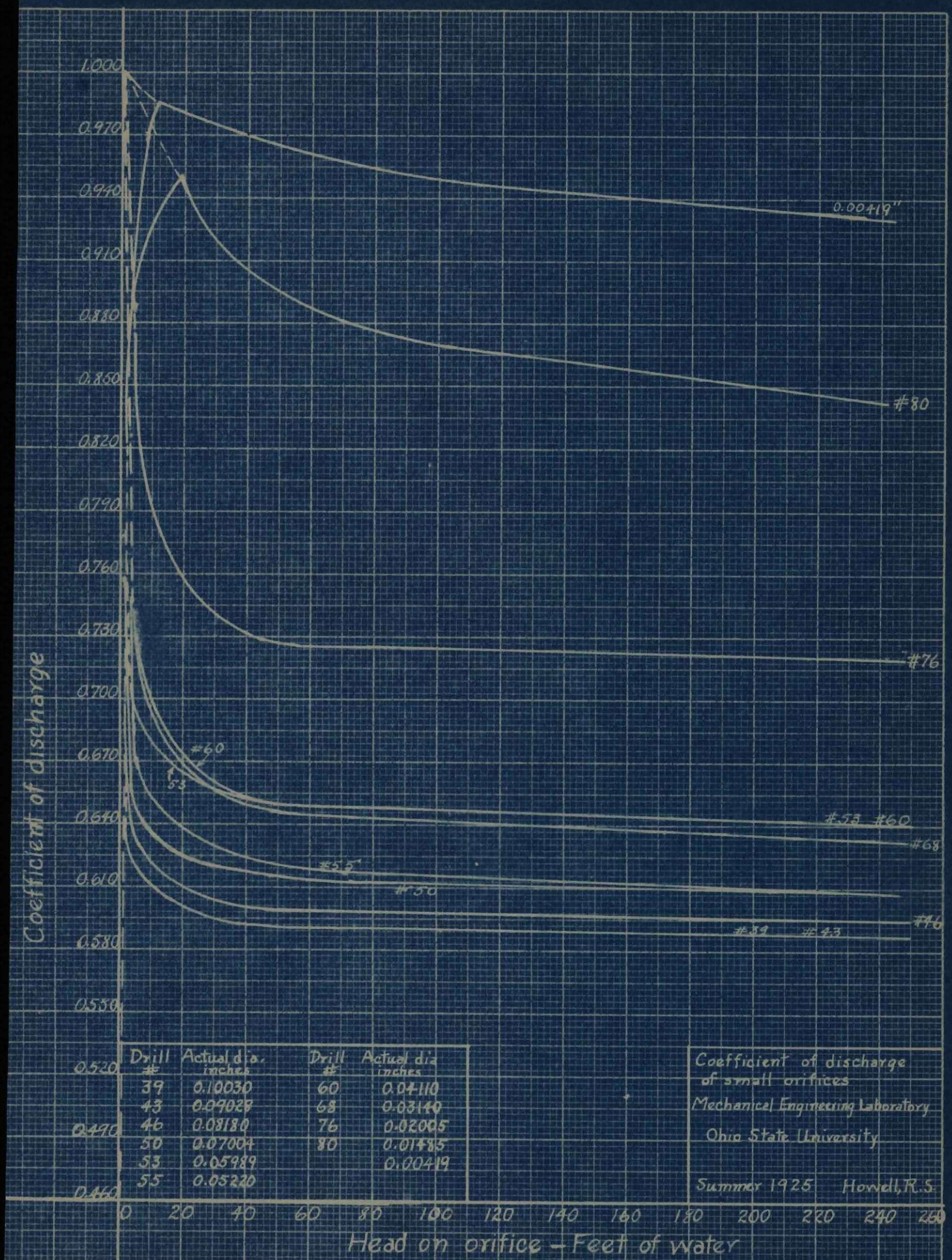
Discharge Curves for Small Orifices

Mechanical Engineering Laboratory
Ohio State University

Summer 1925 Howell, R.S




0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
Water discharged – Cubic feet per hour
0 20 40 60 80 100 120 140 160 180 200 220 240
Head on orifices – Feet of water
#80
0.00419" dia.
Orifice # | Nominal dia inches | Actual dia inches
80 | 0.0135 | 0.0491
0.0040 | 0.00419
Discharge Curves for Small Orifices
Mechanical Engineering Laboratory
Ohio State University
Summer 1925 Howell, R.S.



Drill #	Actual dia. inches	Drill #	Actual dia. inches
39	0.10030	60	0.04110
43	0.09028	68	0.03140
46	0.08180	76	0.02005
50	0.07004	80	0.01485
53	0.05989		0.00419
55	0.05220		

Coefficient of discharge of small orifices

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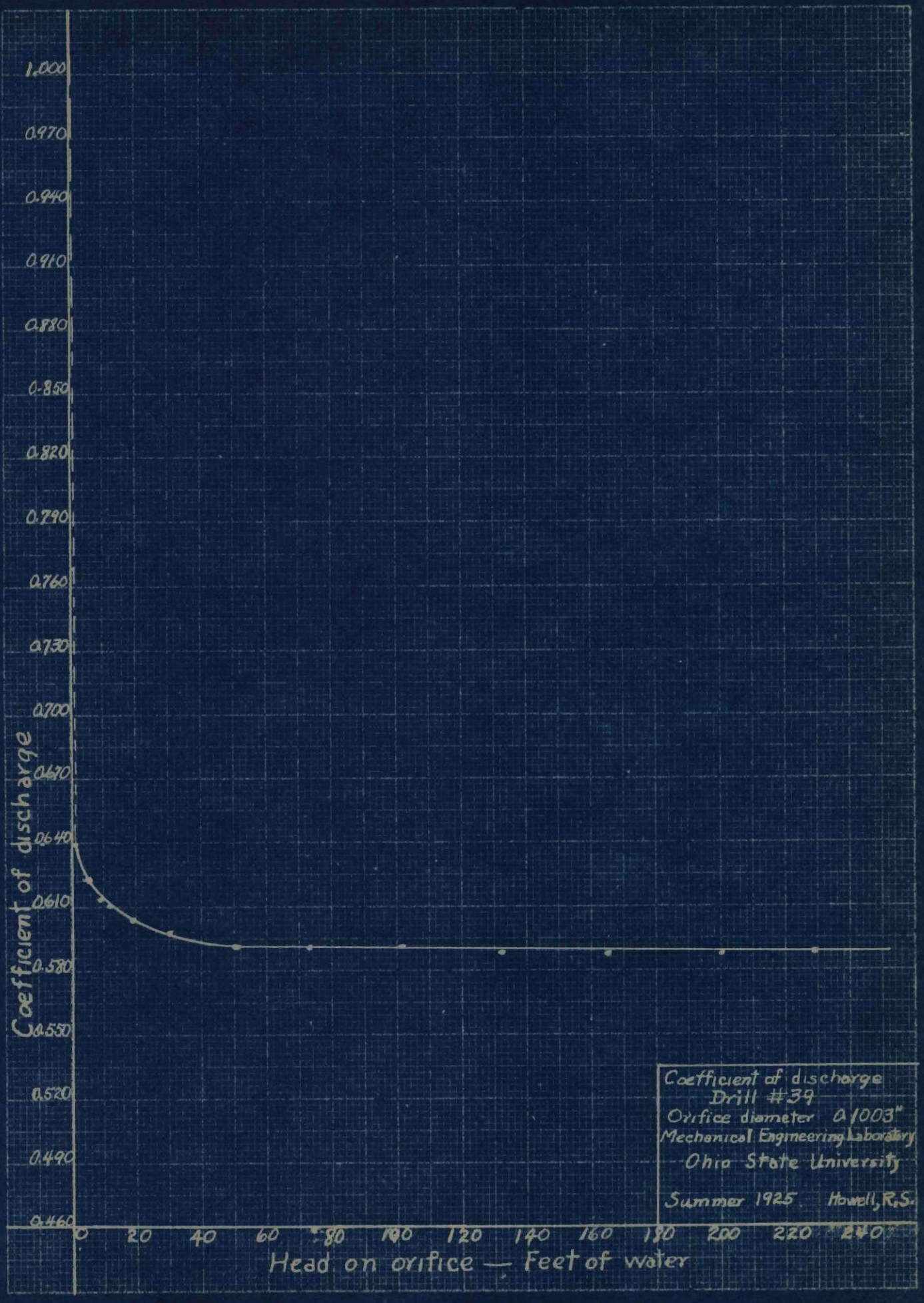

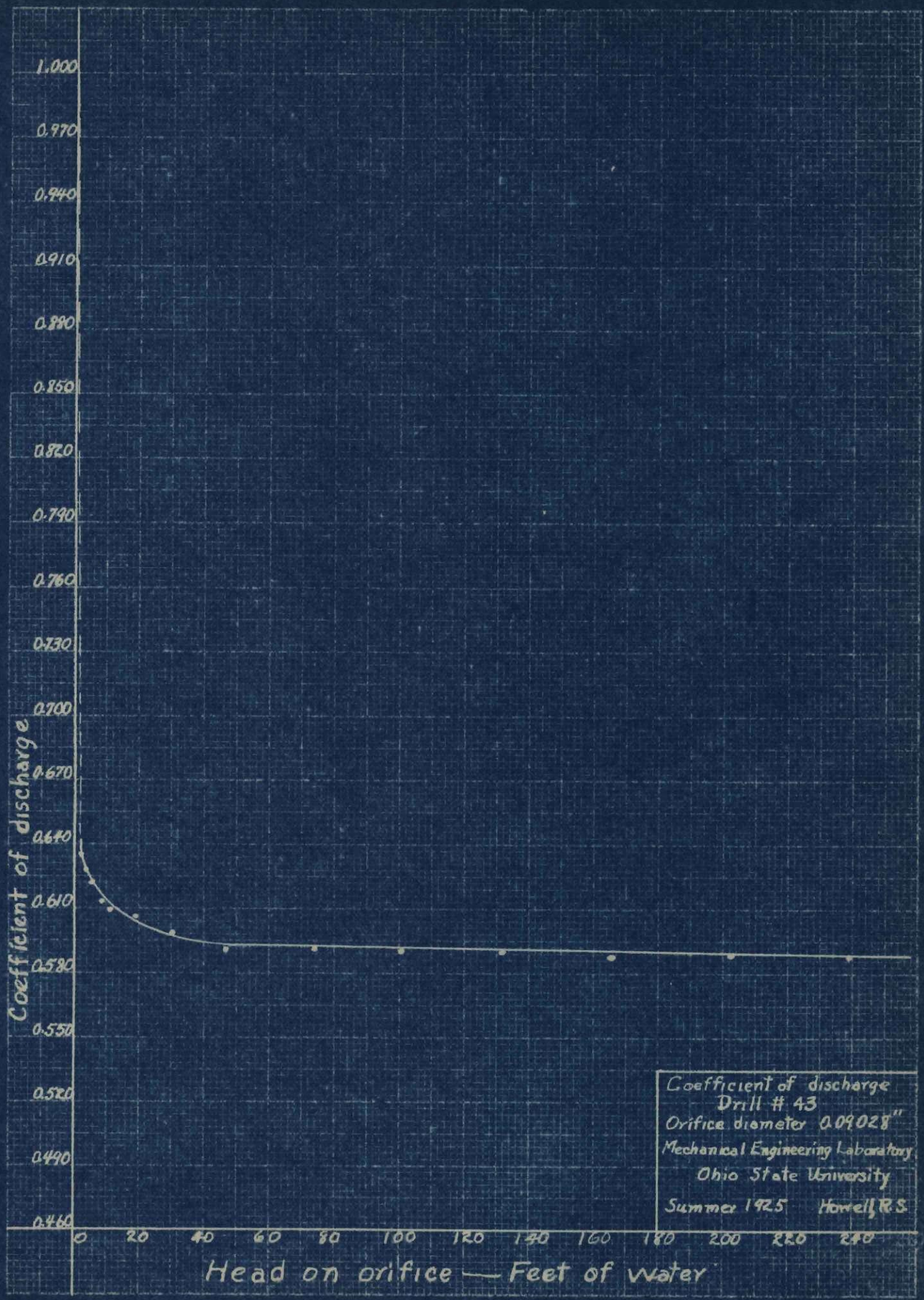

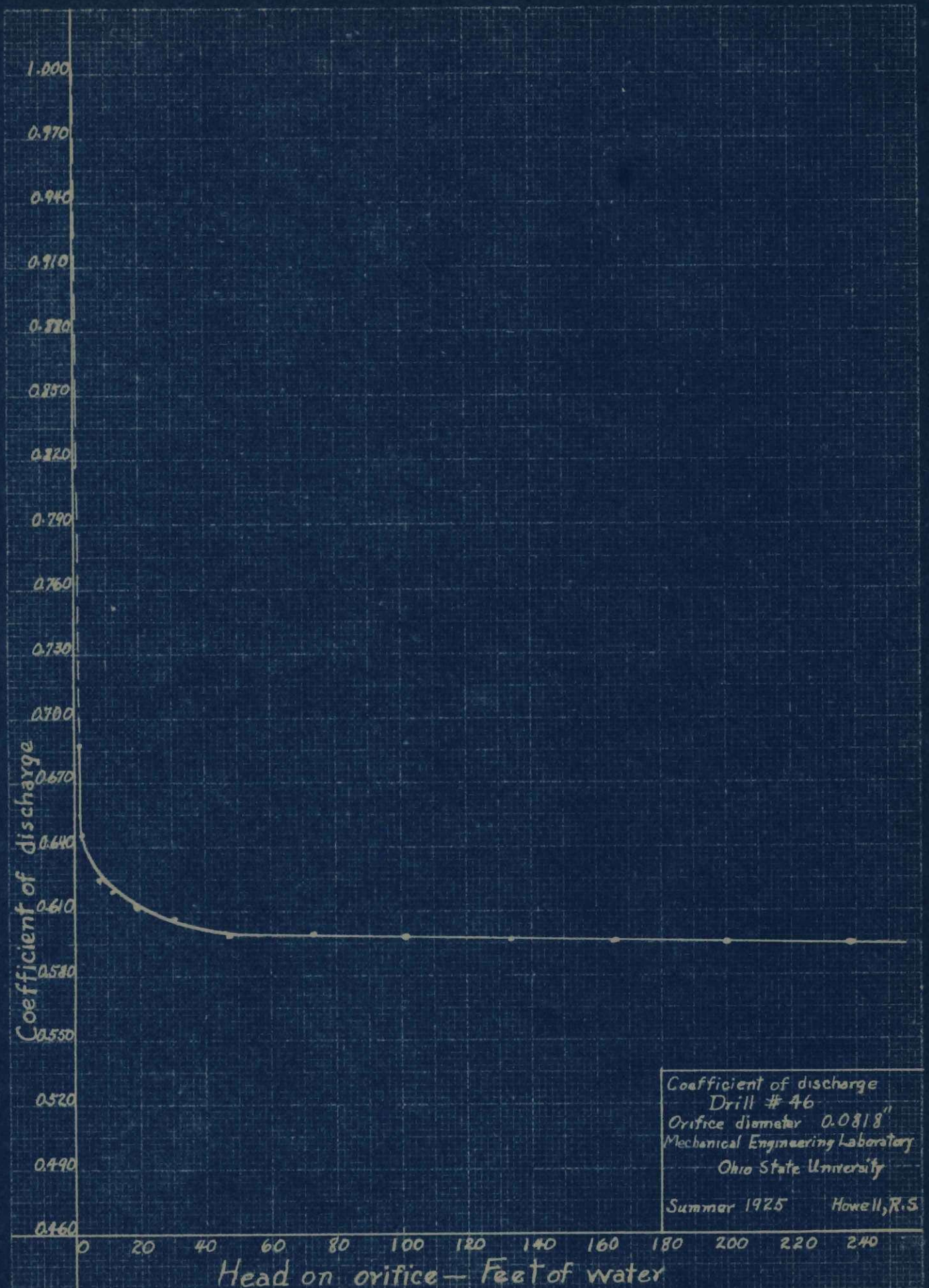

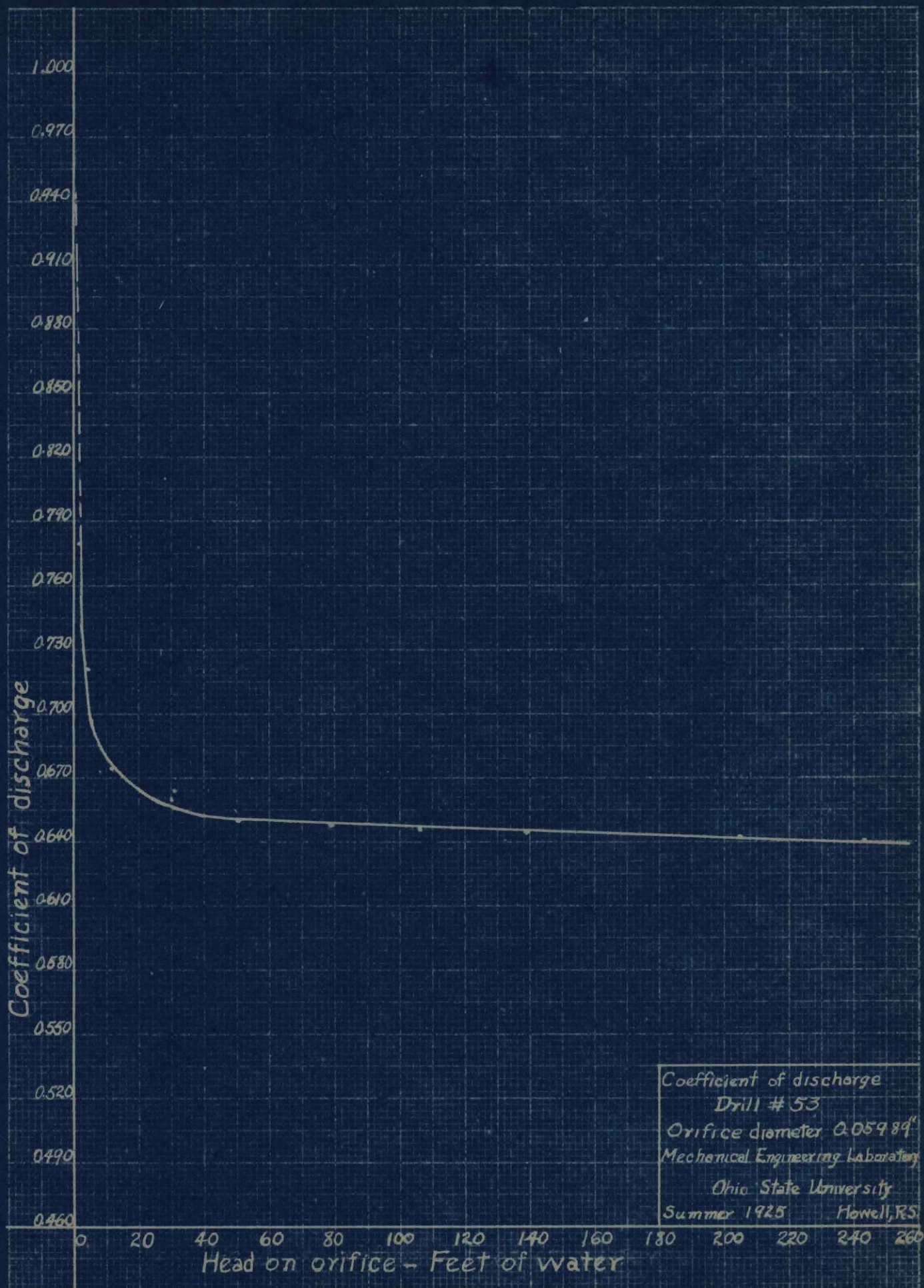

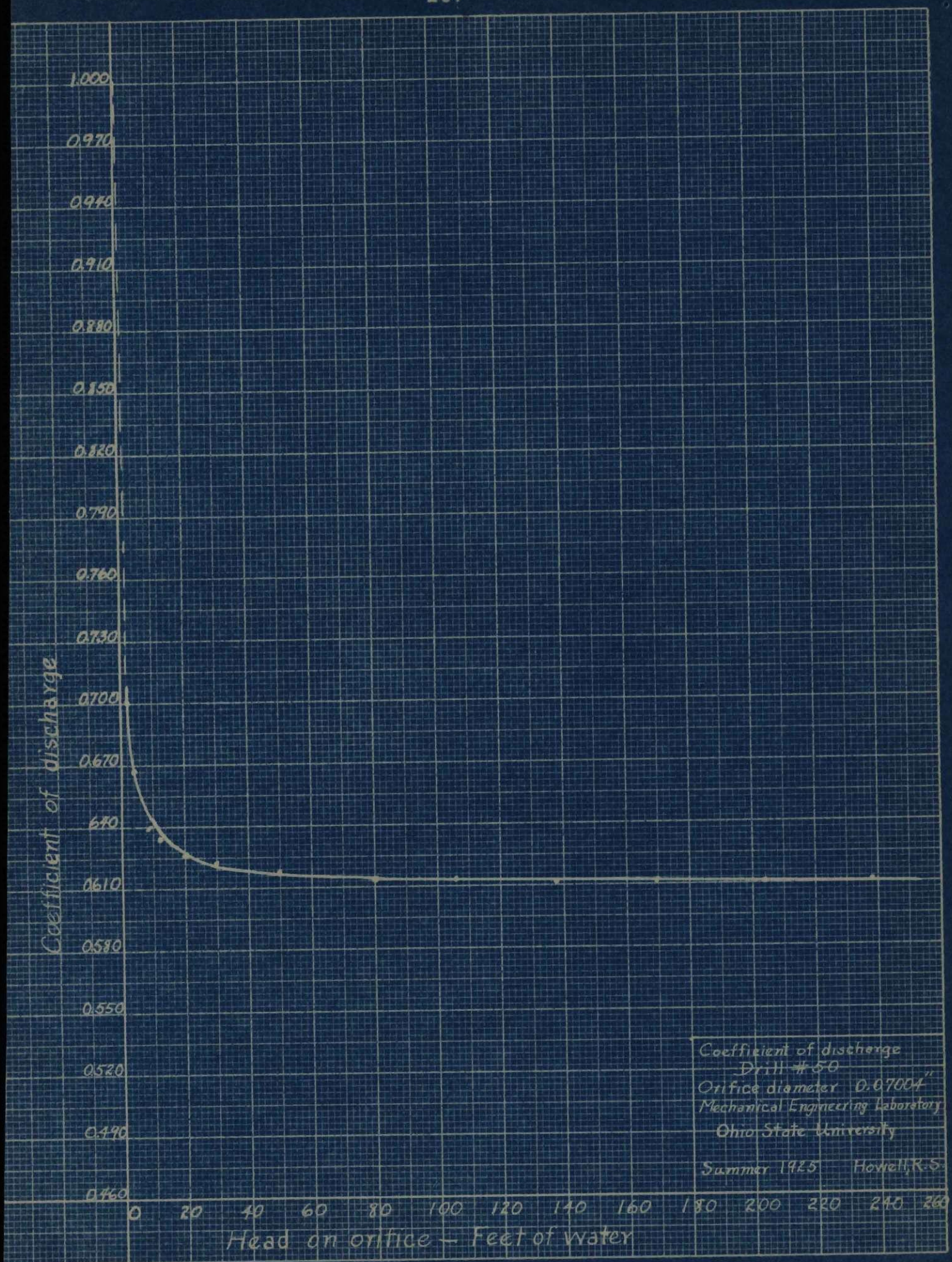
1.000
0.970
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0.910
0.880
0.850
0.820
0.790
0.760
0.730
0.700
0.670
0.640
0.610
0.580
0.550
0.520
0.490
0.460
Coefficient of discharge
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Head on orifice — Feet of water
Coefficient of discharge
Drill #50
Orifice diameter 0.0700 4"
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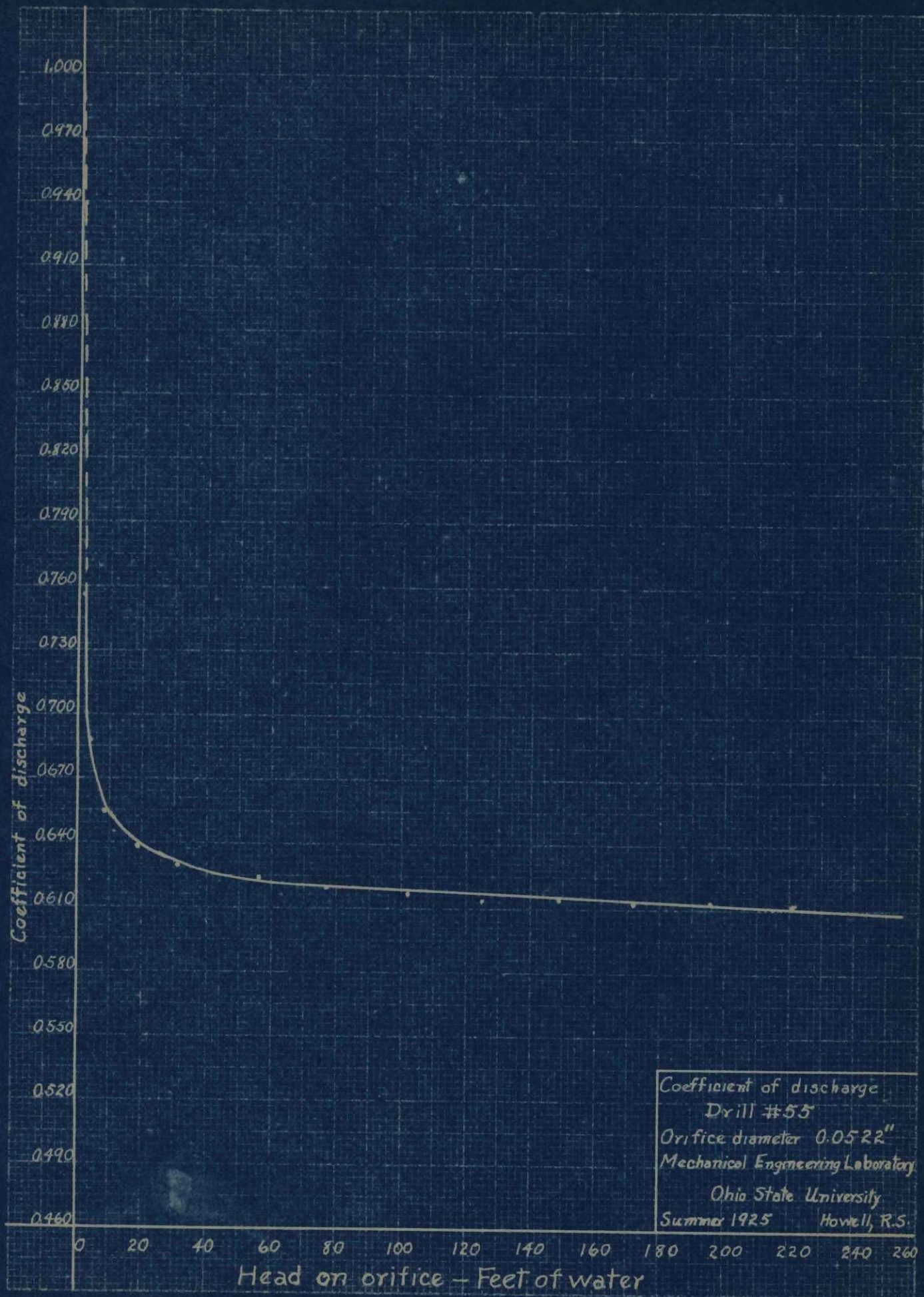

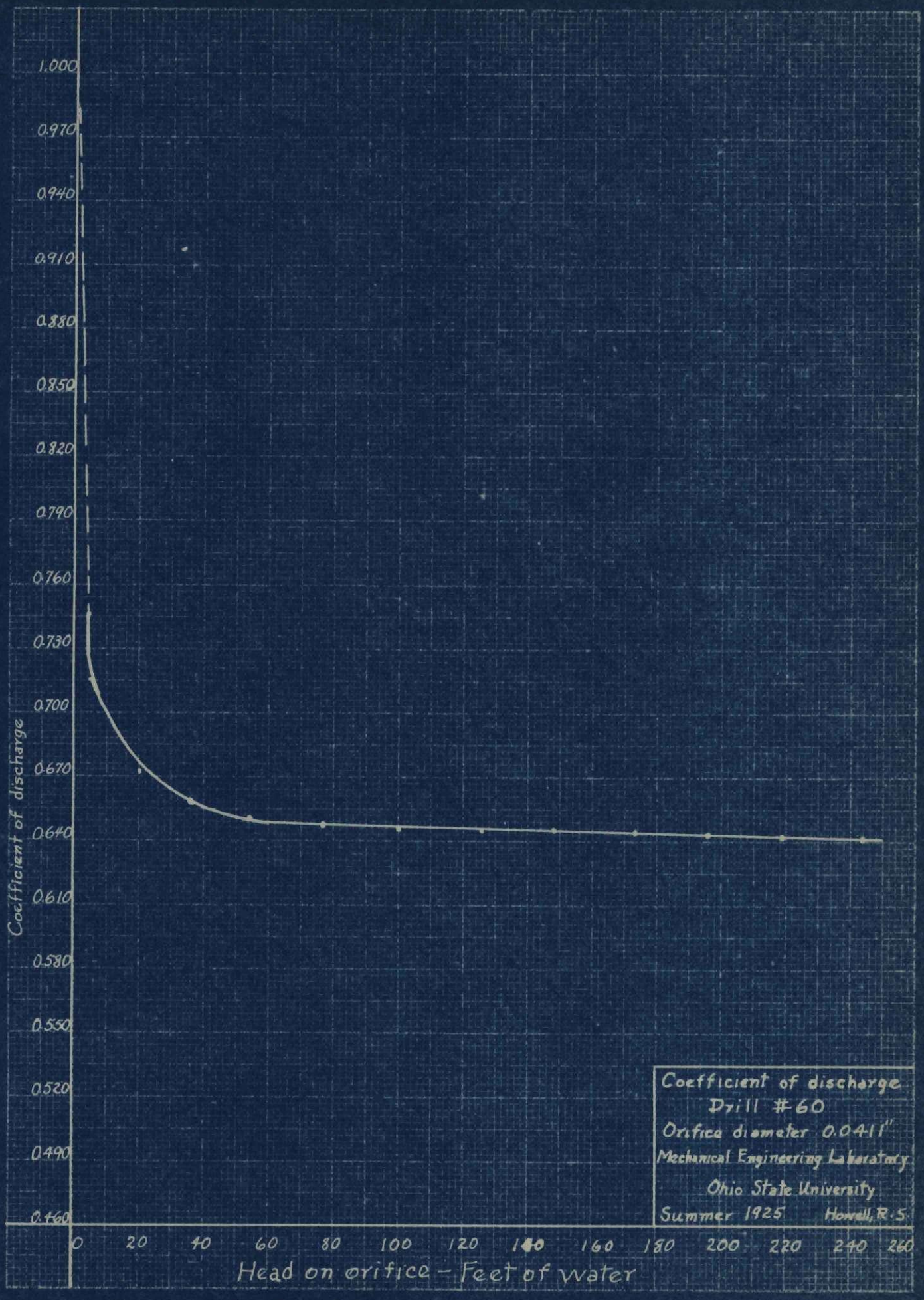

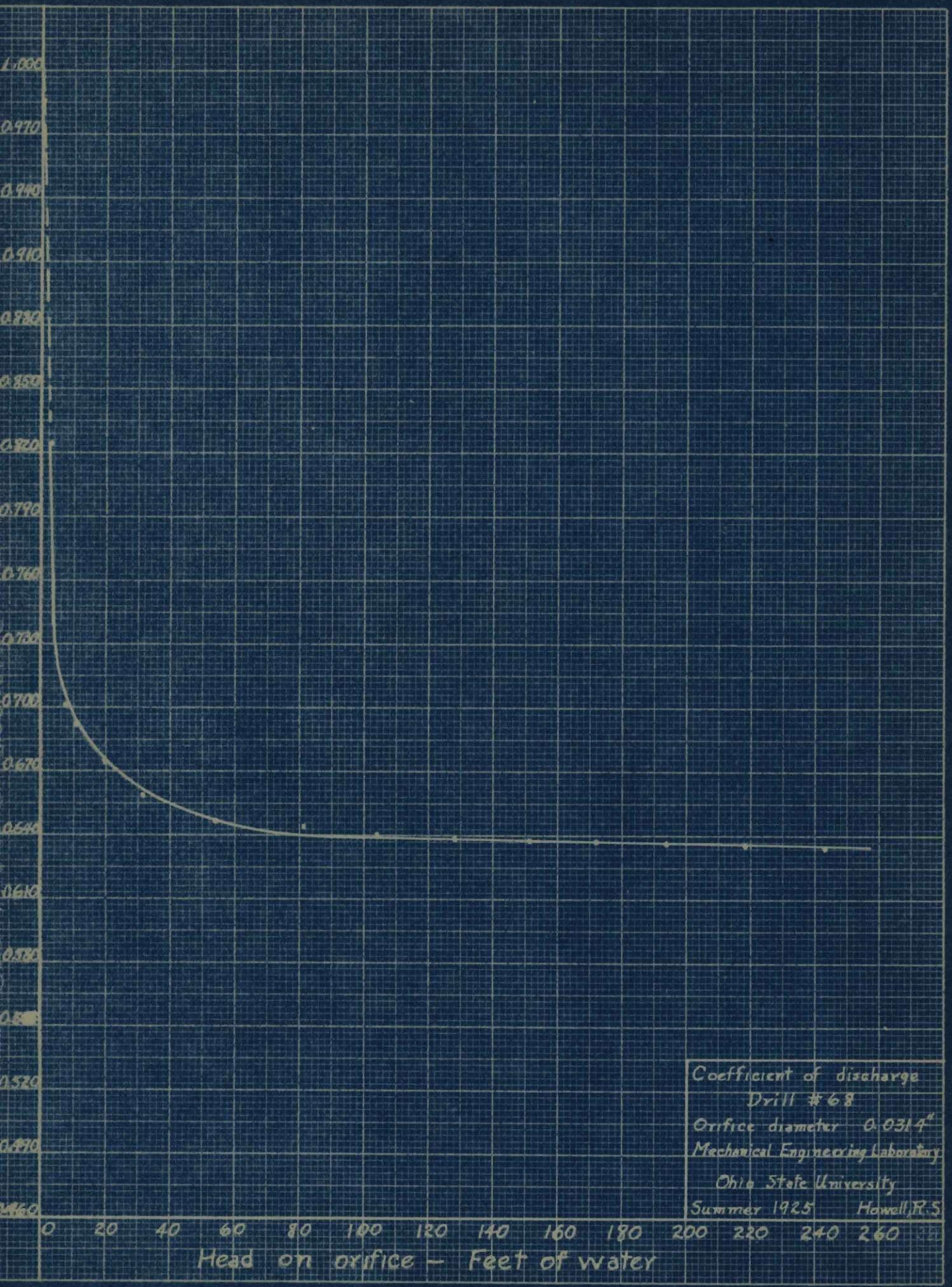
0.970
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20
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60
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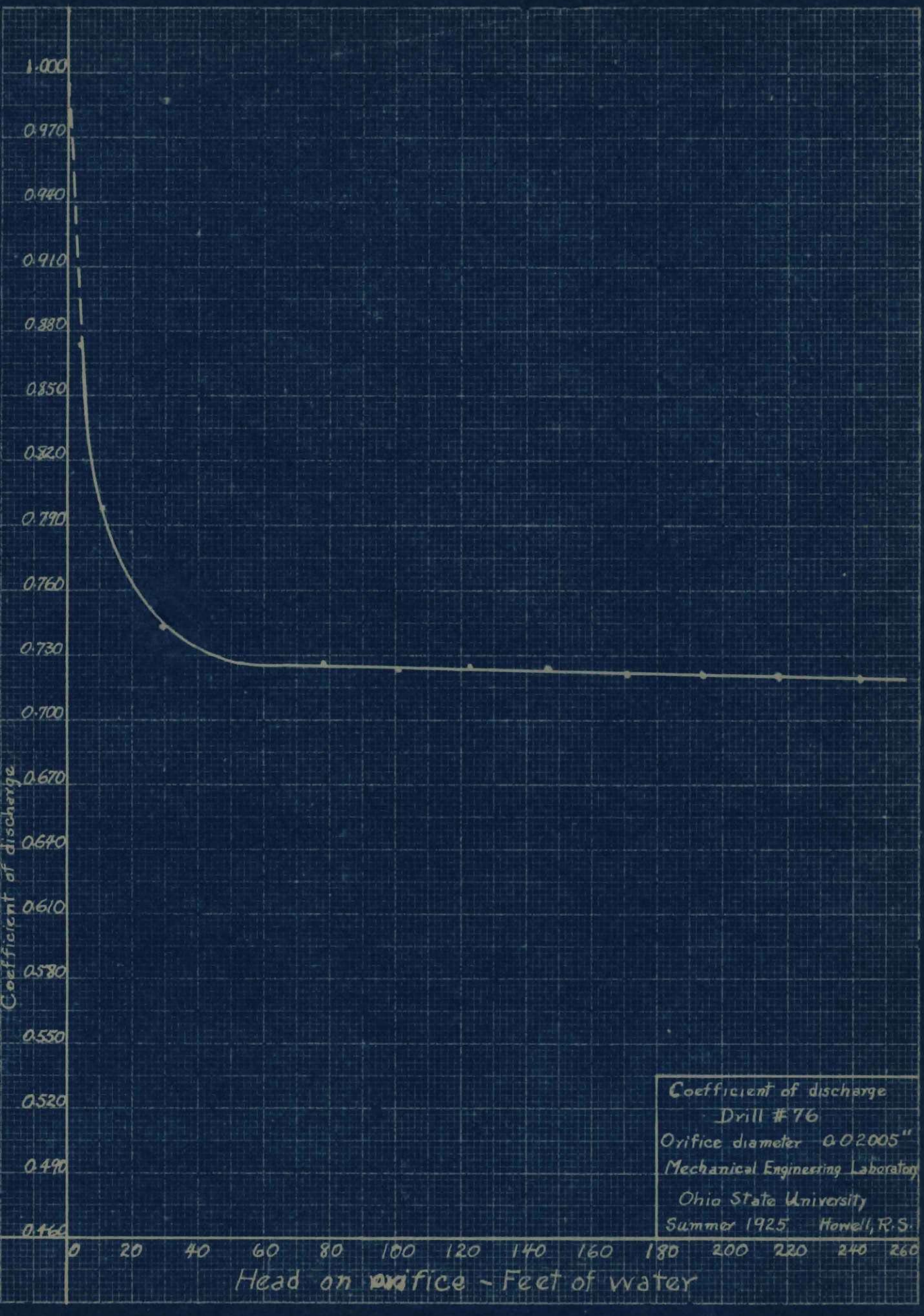
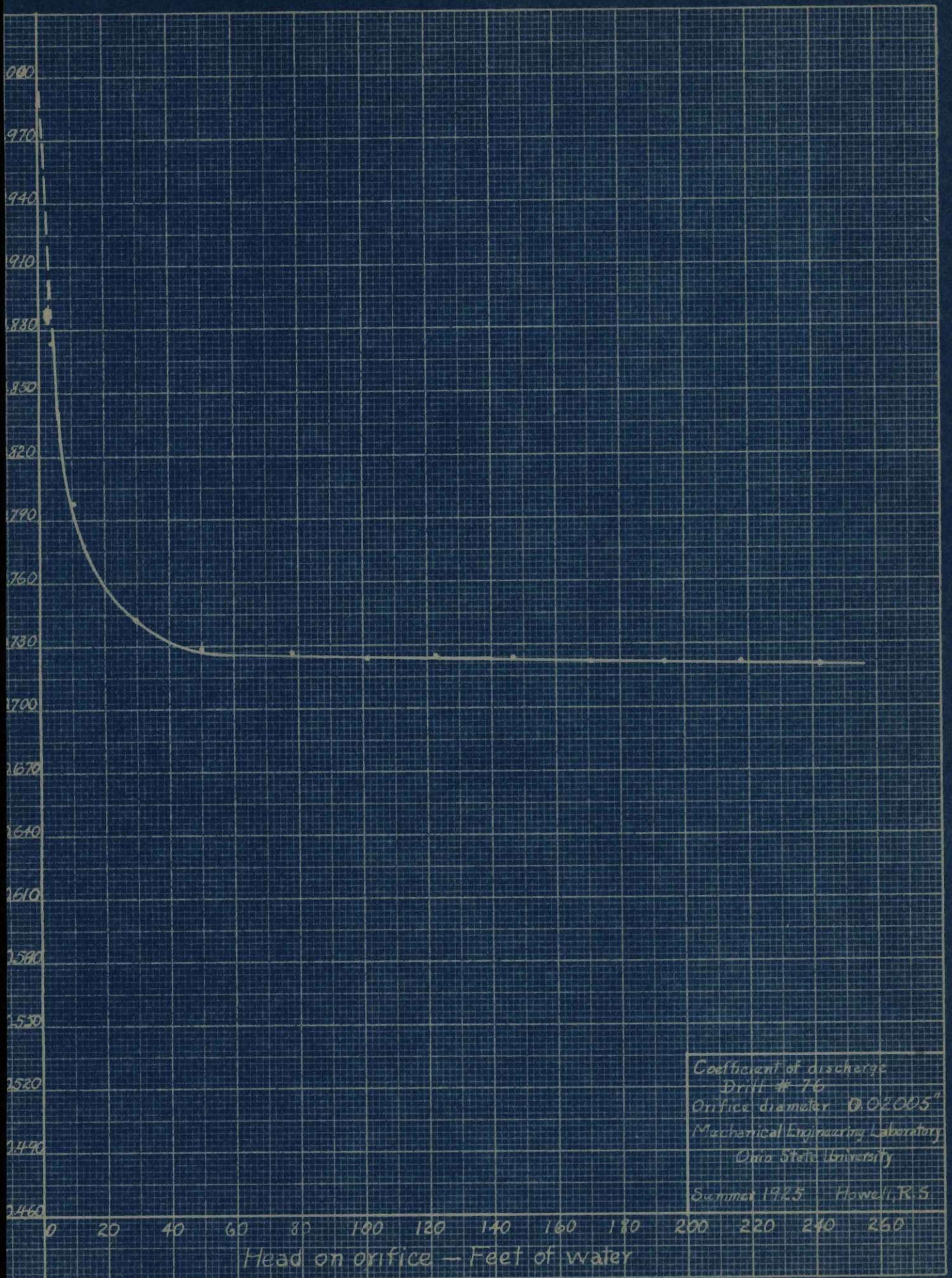
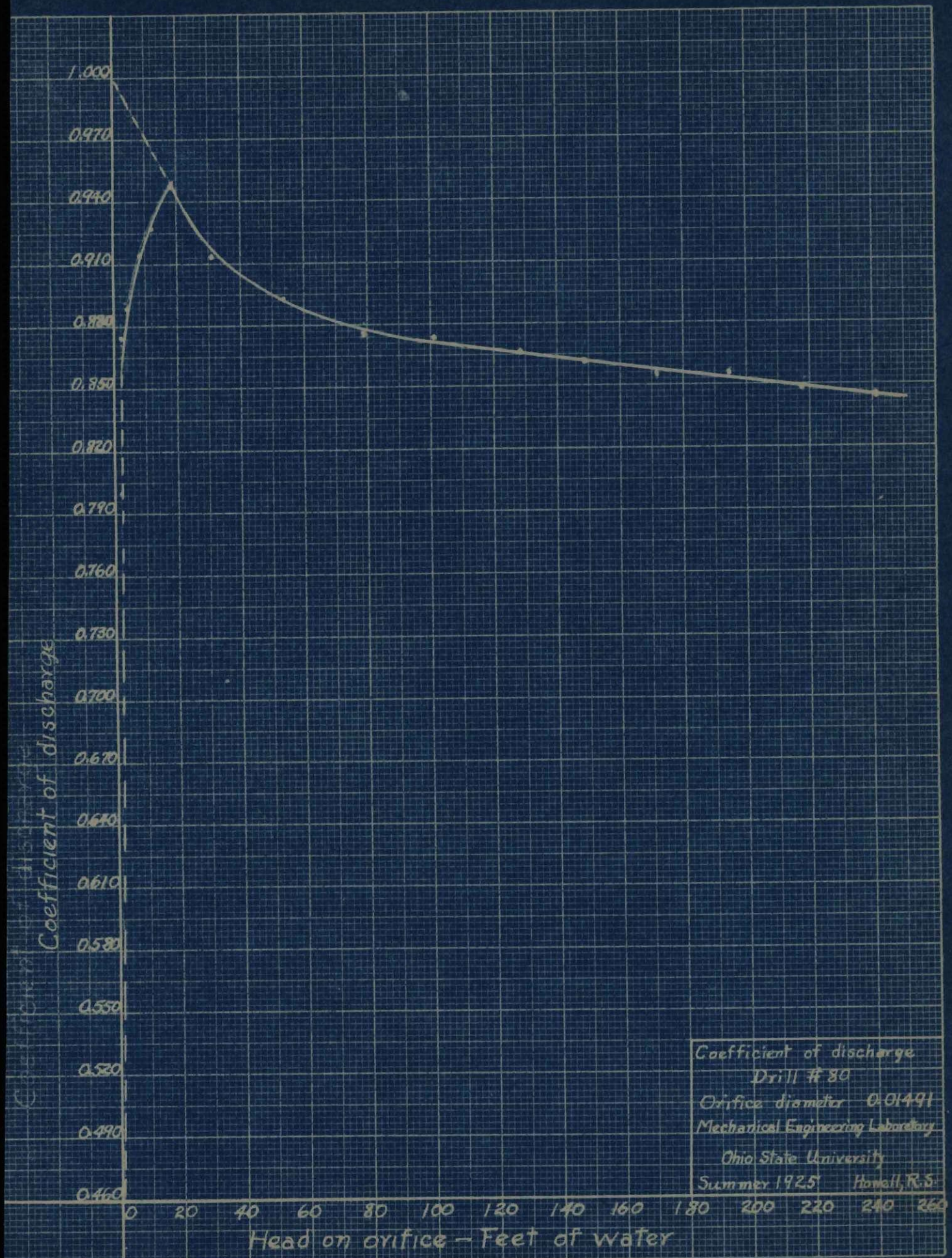
100
120
140
160
180
200
220
240
260
Head on orifice – Feet of water
Coefficient of discharge
Drill #68
Orifice diameter 0.0314"
Mechanical Engineering Laboratory
Ohio State University
Summer 1925 Howell, R.S.




Coefficient of discharge
Drill # 76
Orifice diameter 0.02005"
Mechanical Engineering Laboratory
Ohio State University
Summer 1923 Howell, R.S.
0 20 40 60 80 100 120 140 160 180 200 220 240 260
Head on orifice — Feet of water


1.000
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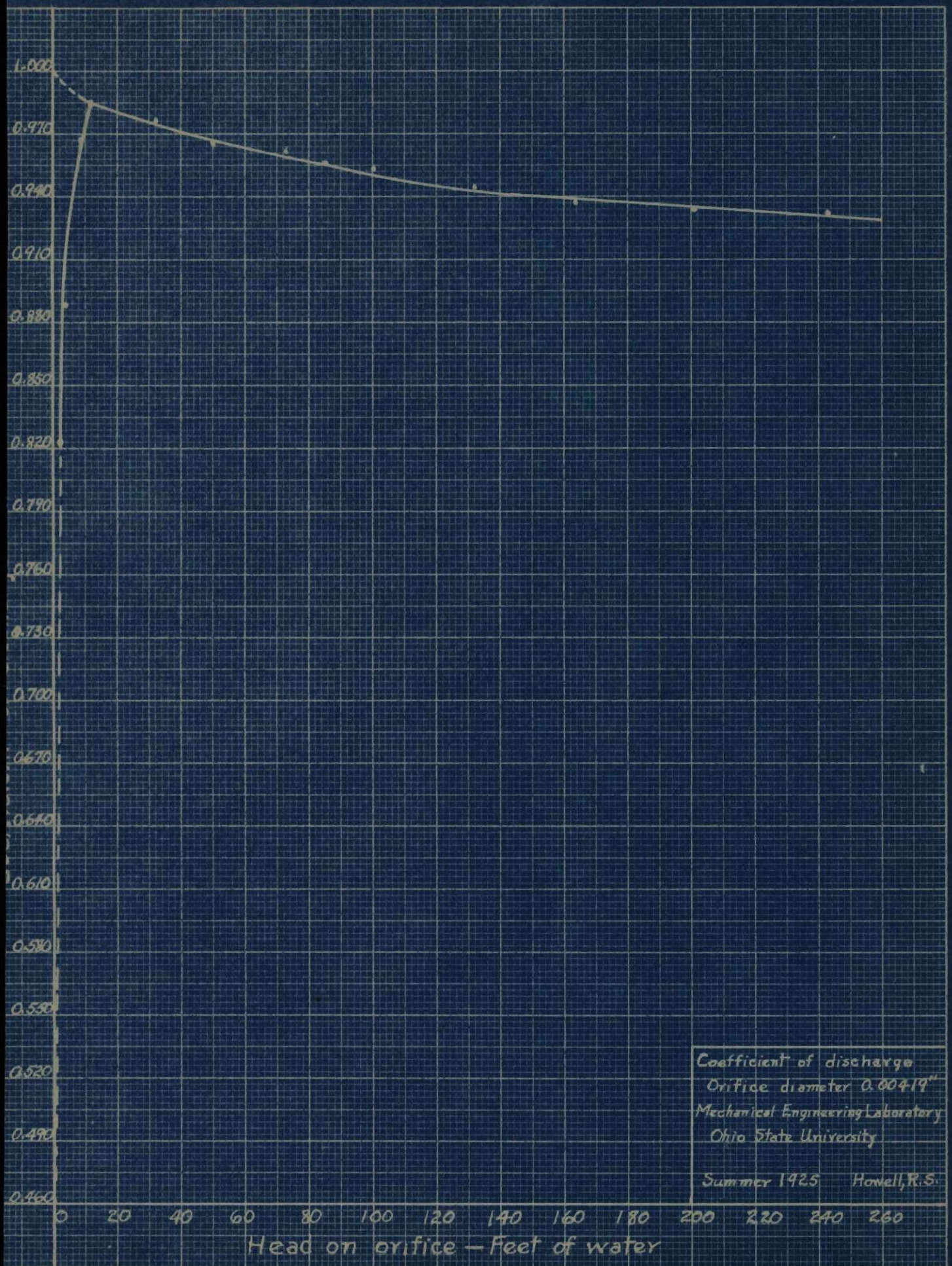
0.820
0.790
0.760
0.730
0.700
0.670
0.640
0.610
0.580
0.550
0.520
0.490
0.460
Coefficient of discharge
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Head on orifice – Feet of water
Coefficient of discharge
Drill # 80
Orifice diameter 0.0149"
Mechanical Engineering Laboratory
Ohio State University
Summer 1925 Howell, R.S.


1.000
0.970
0.940
0.910
0.880
0.850
0.820
0.790
0.760
0.730
0.700
0.670
0.640
0.610
0.580
0.550
0.520
0.490
0.460
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Head on orifice – Feet of water
Coefficient of discharge
Orifice diameter 0.00419"
Mechanical Engineering Laboratory
Ohio State University
Summer 1925 Howell, R.S.

SAMPLE CALCULATIONS
Orifice – Drill # 60

Nominal dia. 0.0400
Actual dia. 0.0411
Actual area 0.0000092132 sq. ft.

Run # 1. Average head by water column 4.044 ft. H_2O. Net weight water 37.87 lbs. Duration run 90 min. = 5400 sec. Temp. water 74°F. unit wt., #/cu.ft. 62.27. Density water 0.99745. Average height water in drum 2.00"

$(4.044 + \frac{2.00}{12})\ 0.99745 = 4.21$ ft. H_2O total head

$V = \sqrt{2gh} = \sqrt{64.4 \times 4.21} = 16.465$ ft./sec.

$q = av = 0.0000092132 \times 16.465 = 0.0001517$ theoretical discharge.

$\frac{37.87}{62.27 \times 5400} = 0.00011262$ cu.ft/sec actual discharge

coefficient of discharge $= \frac{0.00011262}{0.00015170} = 0.742$

Run # 2. Average head by water column 4.13 ft. H_2O. Quantity water discharged, cu.ft. 0.092735. Duration run 13 min – 34.5 sec. = 814.5 sec. Temp. water 74°F. Unit wt. lbs/cu.ft. 62.27. Density water 0.99745. Average height water in drum 1.70"

$(4.13 + \frac{1.70}{12})\ 0.99745 = 4.27$ ft. Total head

$V = \sqrt{2gh} = \sqrt{64.4 \times 4.27} = 16.58$ ft/sec.

$q = av = 0.0000092132 \times 16.58 = 0.00015275$ theoretical discharge

$\frac{0.092735}{814.5} = 0.00011385$ cu/ft/sec actual discharge

coefficient of discharge $= \frac{0.00011385}{0.00015275} = 0.745$

Run #3. Average head by water column 8.12 ft. H_2O. Quantity discharged, cu.ft. 0.092735. Duration run 10 min.–19 sec. = 619 sec. Temp. water 74°F Unit wt, lbs/cu.ft. 62.27. Density water 0.99745. Average height water in drum 1.8"

$(8.12 + \frac{1.8}{12})\ 0.99745 = 8.248$ ft. Total head

$V = \sqrt{2gh} = \sqrt{64.4 \times 8.25} = 23.05$ ft/sec.

$q = av = 0.0000092132 \times 23.05 = 0.00021235$ theoretical discharge

$\frac{0.092735}{619} = 0.00014981$ cu.ft/sec actual discharge

coefficient of discharge $= \frac{0.00014981}{0.00021235} = 0.705$

Run # 4. Average head by manometer 18.0425" Hg. Quantity discharged, cu.ft. 0.092735 Duration run 6 min. – 51 sec. = 411 sec. Temp. water 74°F. Unit wt. lb/cu.ft. 62.27. Density water 0.99745

SAMPLE CALCULATIONS
Orifice – Drill # 60

Run # 4. Con.
Density mercury = 13.58.
Average height water in drum 2.2"
$(\frac{18.0425}{12} \times 13.58) = 20.418$ ft H_2O

$\frac{2.2}{12} \times 0.99745 = 0.182$ ft. H_2O

20.418 + 0.182 = 20.60 ft. Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 20.60} = 36.42$ ft/sec
q=av=0.0000092132 x 36.42 = 0.00033554 theoretical discharge
$\frac{0.092735}{411} = 0.00022563$ cu.ft/sec actual discharge
coefficient of discharge = $\frac{0.00022563}{0.00033554} = 0.672$

Run # 5. Average head by manometer 18.0492" Hg.
Net weight water 42.1. Duration run 50 mins. = 3000 secs.
Temp. water 74° F. Unit wt., lbs/cu.ft. 62.27
Density water 0.99745. Density mercury 13.58.
Average height of water in drum 2.20"
$(\frac{18.0492}{12} \times 13.58) = 20.428$ ft. H_2O
$(\frac{2.20}{12} \times 0.99745) = 0.182$ ft. H_2O
20.428 + 0.182 = 20.61 ft. Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 20.61} = 36.43$ ft/sec
q=av=0.0000092132 x 36.43 = 0.00033563 theoretical discharge
$\frac{42.1}{62.27 \times 3000} = 0.00022536$ cu.ft/sec actual discharge
coefficient of discharge = 0.00022535 = 0.

Run # 6. Average head 26.597" Hg.
Net weight water 40.42. Duration run 40 mins. = 2400 secs.
Temp. water 74°F. Unit wt., lbs/cu.ft. 62.27
Density water 0.99745. Density mercury 13.58
Average height water in drum 2.45"
$(\frac{26.597}{12} \times 13.58) = 30.099$ ft. H_2O
$(\frac{2.45}{12} \times 0.99745) = 0.203$ ft. H_2O
30.099 + 0.203 = 30.302 ft. Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 30.30} = 44.173$ ft/sec.
q=av=0.0000092132 x 44.173 = 0.00040697 theoretical discharge
$\frac{40.42}{62.26 \times 2400} = 0.00027050$ cu.ft/sec. actual discharge
coefficient of discharge = $\frac{0.00027050}{0.00040697} = 0.664$

SAMPLE CALCULATIONS
Orifice – Drill # 60

Run # 7. Average head 23.9 #/□" gage.
Net weight water 39.7 lbs. Duration run 30 mins. = 1800 secs.
Temp. water 74°F. Unit wt., lbs/cu.ft. 62.27
Density water 0.99745. Average height water in drum 2.80"

$$\begin{array}{r} 23.90 \\ .60 \text{ calibration correction} \\ \hline 23.30 \times 2.31 = 53.823 \text{ ft. } H_2O. \end{array}$$

$$\left(\frac{2.80}{12} \times 0.99745\right) = 0.232 \text{ ft. } H_2O$$

$53.823 + 0.232 = 54.065$ Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 54.07} = 59.01$ ft/sec.
$q=av=0.0000092132 \times 59.01 = 0.00054367$ theoretical discharge

$$\frac{39.7}{62.27 \times 1800} = 0.00035419 \text{ cu.ft/sec actual discharge}$$

$$\text{coefficient of discharge} = \frac{0.00035419}{0.00054367} = 0.651$$

Run # 8. Average head 33.62 #/□" gage.
New weight water 43.95. Duration run 28 mins. = 1680 secs.
Temp. water 73°F. Unit wt., lbs/cu/ft. 62.28
Density water 0.99758. Average height water in drum 1.9"

$$\begin{array}{r} 33.62 \\ .40 \text{ calibration correction} \\ \hline 33.22 \times 2.31 = 76.738 \text{ ft. water} \end{array}$$

$$\left(\frac{1.9}{12} \times 0.99758\right) = 0.157 \text{ ft. water}$$

$76.738 + 0.157 = 76.895$ Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 76.9} = 70.373$ ft/sec.
$q=av= 0.0000092132 \times 70.373 = 0.00064836$ theoretical discharge

$$\frac{43.95}{62.28 \times 1680} = 0.00042005 \text{ cu.ft/sec actual discharge}$$

$$\text{coefficient of discharge} = \frac{0.00042005}{0.00064836} = 0.648$$

Run # 9. Average head 43.8 #/□" gage.
Net weight water 53.72 lbs. Duration run 30 mins = 1800 secs.
Temp. water 73°F. Unit wt., lbs/cu.ft. 62.28
Density water 0.99758. Average height water in drum 2.20"

$$\begin{array}{r} 43.80 \\ .38 \text{ calibration correction} \\ \hline 43.42 \times 2.31 = 100.300 \text{ ft. water} \end{array}$$

$$\left(\frac{2.20}{12} \times 0.99758\right) = 0.182 \text{ ft. water}$$

$100.300 + 0.182 = 100.482$ Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 100.48} = 80.44$ ft/sec.
$q=av= 0.0000092132 \times 80.44 = 0.0007411$ cu.ft/sec theoretical discharge

$$\frac{53.72}{62.28 \times 1800} = 0.0004792 \text{ cu.ft/sec.actual discharge}$$

$$\text{coefficient of discharge} = \frac{0.0004792}{0.0007411} = 0.646$$

SAMPLE CALCULATIONS
Orifice – Drill # 60

Run # 10. Average head 54.42 #/□" gage.
Net weight water 60.16. Duration run 30 mins. = 1800 secs.
Temp. water 73°F. Unit wt. lb/cu.ft. 62.28
Density water 0.99758. Average height water in drum 2.425"

54.42
.03 calibration correction
54.45 x 2.31 = 125.779 ft. water
(2.425 / 12 x 0.99758) = 0.201 ft. water
125.779 + 0.201 = 125.98 Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 125.98} = 90.073$ ft/sec.
q=av= 0.0000092132 x 90.073 = 0.00082986 theoretical discharge
60.16 / (62.28 x 1800) = 0.00053664 cu.ft/sec. actual discharge
coefficient of discharge = 0.00053664 / 0.00082986 = 0.646

Run # 11. Average head 64.0 #/□" gage.
Net weight water 65.30 lbs. Duration run 30 mins. = 1800 secs.
Temp. water 73°F. Unit wt., lbs/cu.ft. 62.28
Density water 0.99758. Average height water in drum 2.625"

64.00
.24 calibration correction
64.24 x 2.31 = 148.394 ft. water
(2.625 / 12 x 0.99758) = 0.218 ft. water
148.394 + 0.218 = 148.612 Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 148.61} = 97.83$ ft/sec.
q=av=0.0000092132 x 97.83 = 0.00090132 theoretical discharge
65.30 / (62.28 x 1800) = 0.00058249 cu.ft/sec.actual discharge
coefficient of discharge = 0.00058249 / 0.00090132 = 0.646

Run # 12. Average head 74.64 #/□" gage.
Net weight water 70.33. Duration run 30 mins. = 1800 secs.
Temp. water 73°F. Unit wt., lbs/cu.ft. 62.28
Density water 0.99758. Average height water in drum 2.75"

74.64
.20 calibration correction
74.84 x 2.31 = 172.880 ft. water
(2.75 / 12 x 0.99758) = 0.228 ft. water
172.88 + 0.228 = 173.108 Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 17311} = 105.585$ ft/sec
q=av=0.0000092123 x 105.585 = 0.00097268 theoretical discharge
70.33 / (62.28 x 1800) = 0.00062736 cu.ft/sec. actual discharge
coefficient of discharge = 0.00062736 / 0.00097268 = 0.645

SAMPLE CALCULATIONS
Orifice – Drill # 60

Run # 13. Average head 84.52 #/□" gage.
Net weight water 74.76 lbs. Duration run 30 mins. = 1800 secs.
Temp. water 73°F. Unit wt., lbs/cu.ft. 62.28
Density water 0.99758. Average height water in drum 2.90"

84.52
.21 calibration correction
84.73 x 2.31 = 195.726 ft. water
(2.90/12 x 0.99758) = 0.240 ft. water
197.726 + 0.240 = 195.966 Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 195.97} = 112.34$ ft/sec.
q=av= 0.0000092123 x 112.34 = 0.0010349 theoretical discharge
74.76 / (62.28 x 1800) = 0.00066688 cu.ft/sec. actual discharge
coefficient of discharge = 0.00066688 / 0.0010349 = 0.644

Run # 14. Average head 94.31 #/□" gage.
Net weight water 78.98 . Duration run 30 mins. = 1800 secs.
Temp. water 74°F. Unit wt., lbs/cu.ft. 62.27.
Density water 0.99745. Average height water in drum 3.15"

94.30
.50 calibration correction
94.80 x 2.31 = 218.988 ft. water
(3.15/12 x 0.99745) = 0.262 ft. water
218.988 + 0.262 = 219.25 Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 219.25} = 118.83$ ft/sec.
q=av= 0.0000092123 x 118.83 = 0.0010946 theoretical discharge
78.98 / (62.27 x 1800) = 0.00070463 cu.ft/sec. actual discharge
coefficient of discharge = 0.00070462 / 0.0010946 = 0.643

Run # 15. Average head 104.53 #/□" gage.
Net weight water 83.20 lbs. Duration run 30 mins = 1800 secs.
Temp. water 74°F. Unit weight, lbs/cu.ft. 62.27
Density water 0.99745. Average height water in drum 2.90"

104.53
1.02 calibration correction
105.55 x 2.31 = 243.821 ft. water
(2.90/12 x 0.99745) = 0.240 ft. water
243.821 + 0.240 = 244.061 Total head
$V = \sqrt{2gh} = \sqrt{64.4 \times 244.06} = 125.37$ ft/sec.
q=av= 0.0000092123 x 125.37 = 0.0011549 theoretical discharge
83.20 / (62.27 x 1800) = 0.00074228 cu.ft/sec. actual discharge
coefficient of discharge = 0.00074228 / 0.0011549 = 0.642

The results are shown in blue print form pages 13 to 18.

A complete set of sample computations is given for orifice # 60, pages 115 – 119.

An investigation of the curves seems to indicate the following:

(a) As the diameter of the orifice is decreased the coefficient of discharge approaches unity, minimum value for 0.00419" orifice at high head 0.933, minimum value for largest orifice 0.1003 at high head 0.589.

(b) For each orifice there is a critical head beyond which the coefficient of discharge decreases very slightly with increase in head. As the head is decreased below this critical head the coefficient of discharge increases quite rapidly.

(c) The critical head referred to in (b) increases with a decrease in diameter of the orifice.

(d) Below the critical head the coefficient of discharge approaches unity as the head is decreased.

Mr. H. J. I. Bilton from his experiments described in the proceedings of the Victorian Institute of Engineers – 1908, concluded that as the head decreased the coefficient of discharge approached 0.748, but the results of the present investigation seem to indicate that all curves converge toward unity, neglecting capillarity, viscosity, cohesion, etc.

(e) As the diameter is decreased another critical head is found as the head is decreased. As the head is decreased beyond this second critical head the coefficient of discharge decreases very rapidly and appears to approach the origin. See curves for the two smallest orifices – namely 0.00419 and 0.01491 inches in diameter respectively.

It is probable that this indicates the effect of capillary attraction. It is reasonable to suppose that this attraction might retard the flow to such an extent as to cause the coefficient of discharge to approach zero as the head approaches zero.

(f) The thickness of the orifice plate is approaching the short tube comditions, namely 4 to 5 diameters, as the diameter is decreased and the effect probably increases the coefficient of discharge. This may account for the wide separation of the curves for the

three smallest orifices, namely 0.00419, 0.01491, and 0.02005 inches respectively.

The thickness of the plate for the smallest orifice, 0.00419 inches, was ground to 0.010" in order to eliminate some of the short tube effect.

Another interesting investigation would be a study of the effect of the thickness of the orifice plate upon the coefficient of discharge. Time did not permit of this investigation at this time but it is the writers intention to make a study along this line at a later date.

(g) The measurements taken of the diameter of the jet for the two largest orifices, namely 0.1003 and 0.09028 inches respectively, indicate that the distance of the least section in terms of orifice diameters from the orifice increases as the orifice decreases, especially when compared with the results of Profs. King and Judd upon orifices 3/4 to 2-1/2 inches in diameter.

(h) The length of the smooth section of the jet, namely the length over which the jet holds together, increases quite rapidly as the coefficient of discharge decreases. The length of this section, however, is quite unstable and no especial significance can be attached to the results.

It is hoped that this investigation has added something to the knowledge of science as little has been known of the characteristics of water flow through small openings under both high and low heads. It is readily seen that only the surface of the matter has been scratched in the present investigation and it is hoped that more data upon the subject may be collected later.

Respectfully submitted,